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Forest Machinery

WORLD CROPS

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A Publication of The Leonard Hill Technical Group

The Trojan Bale-Master fits any tractor.
It conveys and stacks 40 bales of hay at one time

Further details on page 248

Tomato-red

Nestling at the foot of the eternally snow-capped Andes is lovely, flower-strewn Mendoza. Here is a happy place; a sunny, fertile garden in which vines, tomatoes and other crops thrive . . . if they are allowed to. The 'serpent' in this 'garden' is the root-knot nematode—a tiny, worm-like creature that lives on the roots of many crops throughout the world. In Mendoza, tomato plants have wilted and died in the sun, yields have declined . . . part of the havoc wreaked by the unseen nematodes. Shell D-D is the prescription—and the remedy. In nematode-infested fields, the authorities injected this yield-increasing soil fumigant two weeks before planting. At harvest time, the tomatoes were picked and weighed. The crop was *three and a half times greater* than that from untreated ground.

Hope had become reality. With D-D, land that had become unfit for tomato-growing was brought into cultivation again. Today, the fields around Mendoza blush red with tomatoes. Similarly, with other crops throughout the world, D-D has rid the soil of nematodes and brought new hope—and new wealth—to growers everywhere. Between them, D-D, Nemagon, aldrin, dieldrin, endrin, and Phosdrin control virtually every major world pest. **D-D**

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Editorial Comment

Forests of the World

FROM THE World Forest Inventory, just published by FAO, we learn that a third of the land area of the world is covered by forests—an area of nearly 11 million acres, of which 7 million are reasonably accessible. The standing timber of the 4 million acres at present under active exploitation amounts to over 155 thousand million cu. m., with an annual growth rate of some 2.8 thousand cu. m. These are impressive figures and a measure of the importance of the world's forest industries.

Although from the statistics it would appear that the proportion of land under forest is greatest in South America at 54%, the U.S.S.R. has the largest area of forest, nearly 3,000 million acres, which is 26% of the world total. South America has 21%, North America and Africa have 17% each, Asia accounts for 12%, Europe has 3%, and Central America and the Pacific have only 2% each.

In terms of population, South America with 18 acres per person is the best endowed; the Pacific has 16, Russia 5.5, North America 3.8, Africa 3.4, Central America 1.4, but Europe and Asia each have less than an acre per head of the population.

Further, according to this inventory, it would appear that less than half of the forests now being exploited are non-coniferous, though over two-thirds of the forests not yet exploited are in this class. Conifers predominate in the industrially developed regions, and this, we imagine, is one reason for their greater exploitation, and the non-conifers are also less well adapted to mechanical and chemical transformation, although new technological developments are expanding their uses.

Improving Forest Trees

TREE PLANTING is necessary not only to increase the area of forested land, but also to make cultivated lands more productive. These objectives can be met quickly by planting any species that will grow, but in the light of experience it has become evident that species for planting need to be chosen more carefully, and research has shown the importance of geographic sources of seed of the species selected for planting. Failures have arisen in the past due to using seed from outside a country or from other regions in the same country with insufficient regard to latitude, altitude, temperature minima and maxima, incidence of drought and rainfall averages at the planting site *vis-a-vis* those of the source of the seed.

In Europe seed from low-altitude larch produced failures at higher altitudes because the needle growth continued so late in autumn that frost in early winter killed the new growth; conversely, seeds of high-altitude larch, when planted at low elevations, yielded unsatisfactory trees. In North America green ash in the plains regions of the U.S.A. have shown differences in drought resistance which can be correlated with drought occurrence in the locality of the parent trees. Time of bud bursting and time of leaf dropping also varied. Such differences have led to the recognition of geographic races as strains of a species which over centuries have become adapted to growing under certain conditions of day length, of growing season—especially the number of frost-free days—of temperature and of water supply.

The conclusions of experience in Europe and North America are to (1) observe existing plantations; (2) use only seed of known origin; (3) keep accurate records of origin based on certification of suppliers; (4) sow local seeds; those grown in similar climates within an agreed distance (100 miles in the U.S.A.) of the planting site and within 1,000 ft. altitudinal difference in preference to outside seeds.

Obviously when the supply of local seed is inadequate, or when outside seed has been definitely shown by systematic trials to produce desirable trees, then outside seed can be used.

In the World Seed Campaign, attention is being directed at geographic sources of seed. This is where foresters in each country can help if their records are adequate, or else simple field trials can be started to obtain data in a comparatively short time.

What of the Future?

IN ASSESSING the wood supply of the world a key figure is the net increment, for so long as the growth rate remains higher than the fellings production at existing or higher levels can be sustained. It is comforting, therefore, to learn that on a regional and world basis growth exceeds fellings by a comfortable margin.

Growth amounts to about 2.8 million cu. m. per year, but from this must be deducted the volume of losses due to fire, pests and diseases, and the effects of shifting cultivation, which in all amount to 0.4 million cu. m., leaving a net growth rate of about 2.4 million cu. m.

The average annual removals during the period 1955-57 totalled 1.6 million cu. m. per annum and 53% of this was of the coniferous species. The margin is thus 0.8 million cu. m.

North America, with 35% of the world's industrial wood production, was the leading region; the U.S.S.R. produced 24%, Europe 22%, Asia 10%, South America and the Pacific each 2%, and Central America and Africa only 1% each. Asia was the leading firewood producer and responsible for 23% of the fuel wood removals during the period under review.

The total reafforestation during the five-year period amounted to nearly 10 million acres—a considerable

advance on the previous period. The largest areas of afforestation are reported to be Spain, South Korea, Poland, Congoland, Japan and Taiwan.

Forestry Research in Britain

THE COMMONWEALTH and, for that matter, world forestry will benefit from the recent extension of the Alice Holt research laboratories, for this research station, situated on the borders of Surrey and Hampshire, is visited by hundreds of research workers from all over the world, and the results of its work are disseminated through the publications of the Commonwealth Forestry Conference and the International Union of Forest Research Organisations.

A magnificent three-story building houses a seed-testing laboratory with facilities for the cold storage of tree seed, a tree-breeding laboratory, a soils laboratory to study the mineral nutrition of trees, divisions for the study of pests and diseases which afflict forest trees, a forest machinery research section, and a statistical division where electrical digital computers are used to analyse the data obtained from the experimental work of the other divisions.

Immense Possibilities of Research

OF ALL the crops cultivated by man, forest trees have received the least attention; the potentialities for improvement are unknown and unexplored, but they are undoubtedly considerable.

Forestry research is obviously a matter of major importance and it is indeed surprising that so little has been done to produce bigger and better trees—trees with more vigour, better form, finer branches, and trees more resistant to pests and diseases. Attention also needs to be given to the production of quick-growing trees and of timbers for special purposes.

The production of new varieties by means of controlled crossings is slow work— to produce a hybrid will take seven or eight years and to prove it eight to ten years more. The female flowers of a selected tree are isolated by means of polythene bags before they open and when they are receptive live pollen from selected trees is injected into the bag with a small pollen gun. The pollen may have been freshly collected, or it may have been dried and kept in cold storage for many years, but it needs to be tested to see that it is viable.

Such testing may either involve the actual germination of the grains in a warm, moist atmosphere, or staining the living nucleus with tetrazolium to see whether or not the grains are live and capable of germinating and fertilising the female flower. If the pollen is of very low viability, it may be necessary to winnow away the dead grains in a fractionator to ensure that more live grains reach the female flowers.

Two methods are being used at Alice Holt. One is the selection of the best trees standing in the forests as seed producers, and then cross-breeding both within a species and between species. This method will not do for trees that are slow to produce seed; in this case the method used is propagation by grafting, using outstanding specimens as parent trees.

Forest pests are not at present very serious in Britain, but two recent epidemics of the pine looper, *Bupalus pinarius*, were effectively dealt with by spraying the affected areas from the air.

The detection of disease in its early stages in tall trees is not always possible; nevertheless, we learned that there are many methods of controlling and mitigating the effects of the damage done by fungi, bacteria and viruses and by other agencies, such as frost, drought and waterlogging.

On Climbing Trees

ONE OF the practical problems of forestry research is how to get to the top of a tree to apply pollen under controlled conditions, or for the collection of seed, or to spray the flowers or foliage.

In Ceylon this can be done by men who are able to climb the bare trunk of a 70-ft. coconut palm either without any aid whatever or, at most, using only an ankle ring; more recently a tractor-drawn extendible ladder was devised, but this was only suitable for palms of medium size. Another device, seen at the N.I.A.E. open day in May, was a hinged folding tong of great strength, which was used to raise a bucket containing the operator to any desired height to prune fruit trees, harvest the crop or spray them with insecticides or fungicides.

At Alice Holt, various other methods were demonstrated. Among these may be mentioned the use of extendible aluminium ladders and nylon safety ropes, while for more extensive work a huge scrambling net was thrown over the foliage so that the operator could apply pollen to all the flowers on a single tree without any real danger or difficulty.

Freedom from Hunger

FERTILISERS CAN play an important part in improving the food supplies in areas where there is already a deficiency and yet populations are still remorselessly increasing.

This conclusion was reached by 41 representatives of the fertiliser industry who met in Rome last April to discuss the position. They recommended that FAO should invite the world fertiliser industries to contribute $1 million over two years for an international campaign to encourage and promote the efficient use of fertilisers in support of the Freedom-from-Hunger Campaign.

The proposals include the organisation of fertiliser trials on the fields of the cultivators and extensive demonstrations of fertilisers in the countries requiring such aid. This will involve the establishment of soil

testing laboratories and advisory services to encourage the increased and more efficient use of fertilisers.

This will be a tremendous undertaking in itself, but it is only the beginning, the essential preliminary to making recommendations regarding the inclusion of fertilisers in plans for foreign aid.

Travelling Circus

A MODERN, up-to-the-minute circus in scarlet and gold has been touring Britain and has visited Yorkshire, Leicestershire, Essex, Sussex, Somerset, Gloucestershire, Buckinghamshire, Hereford, Shropshire and Lancashire in turn to demonstrate a monster one-man silage combine—the 'Super-Hurricane'—together with other units of the *David Brown* range of silage-making equipment, shown for purpose of comparison.

Hitherto green crops have been gathered by these forage harvesters, which cut and blow the material into trailers. Then, on arrival at the silo, it is necessary to use buck-rakes, stationary blowers, or even a gang of men to pitchfork the material over the floor.

The new one-man in-line outfit combines a moving-floor trailer with a rear-mounted forage harvester, so giving automatic cutting, loading, transporting and unloading in a single machine. In addition, there is a cross-conveyor attachment, which may be fitted to give direct discharge of the cut crop on to the ground or up into long mangers, otherwise known as 'zero grazing'.

Normally, however, the cut crop is discharged at the silo by blanking off the chute of the forage harvester; the moving-floor mechanism in the forage box is then set in motion and the crop is fed by three sets of shredders to the rotating flails, which blow it out through a rear opening in a veritable hurricane of twice-bruised cut grass, which spreads evenly over a wide area on the floor of the silo and builds up as an evenly consolidated stack without the dangerous operation of running over the stack with a tractor.

All this represents an important break-through in the design of silage-making equipment. The machine used in these demonstrations was the prototype model, which we first saw last year at Smithfield Show. Now, with the 'first cut' of spring, it has been possible to put this revolutionary machine through its paces under a wide variety of conditions and at the same time give farmers the opportunity of seeing it in action and expressing their opinion before the design is finalised in the light of experience thus gained in the field.

We saw the machine operating both in heavy rain on the slippery clay of the Sussex Weald and in dry conditions in sunshine. Naturally, the wet conditions proved a little troublesome, for the cut grass was inclined to cake on discharge, but the heavy silage combine, even with its 3-ton load of grass, travelled easily uphill over a churned-up surface on which cars were skidding.

Swift, Smooth and Silent Service

THOSE WHO have waited—as we have waited—'below the salt' at a large public banquet, where the 'service' has not been adequate to the occasion, who have only reached the fish course, when the heaven-born at the top table are nearly through with the roast, they, like ourselves at a recent press conference, will appreciate the merits of the Cary-White belt conveyors in providing swift, smooth and silent service.

The reason for calling this press conference was to announce the amalgamation of the Cary and White interests for the manufacture, marketing and distribution of their conveyors and grain elevators on a world basis, and to inspect a very large grain storage and conditioning unit, equipped with their plant, on a farm near Chelmsford in Essex. This installation was designed to handle 20,000 tons of grain and serve 2,500 acres; the cost was met by the better prices which the farmer can obtain by withholding and selling his grain when prices are high.

Contrary to general belief, experiments have shown that grain will remain on a flat belt without falling off and delivery can be cleanly effected at any point, on either side, by means of a patent off-loader, consisting of a twin pulley unit and delivery chute. This unit can be moved along the belt and quickly arranged to deliver the grain into any one of a battery of Crittall storage silos arranged in line on either side of the conveyor.

'Until our land reclamation project this whole area was nothing but swamp'

The installation included an overhead delivery bin for top-loading by gravity into tanker lorries. Unfortunately, the millers still follow the antiquated system of delivery in bags because they have not brought their mills up to date and astonishingly have no facilities for receiving bulk deliveries of grain (see WORLD CROPS, 1959, 11, 88). This, indeed, is an extraordinary situation in a country which claims to have the most mechanised farming in the world!

This system will solve the problems of large farmers, syndicates of farmers and co-operative societies in all parts of the world wherever large quantities of rice, wheat, coarse grains and pulses have to be handled. The change over from bags to bulk handling is inevitable, as the saving in labour, in bags and in floor space is obviously enormous.

Afterwards an excellent lunch was enjoyed in the old-world dining room of Ifield Hall, where, in striking contrast to the raftered ceiling, the main table was a Cary-White conveyor specially adapted for the occasion, and the whole meal was served to a large gathering by our two hostesses alone. The plates were received from the serving hatch and were passed swiftly, smoothly, silently and without even spilling the soup down the table and came to rest with a plate in front of each guest; empty dishes were returned in the same way, by reversing the movement.

This Month's Cover Picture

The Trojan 'Bale-Master' and 'Gale-Bale' sledge completely mechanise bale handling.

The sledge is towed behind the baler, on to which the operator stacks the bales as they are delivered. When there are 20 bales on the sledge they are mechanically discharged in a neat stack to await collection by the 'Bale-Master'.

The 'Bale-Master', which can be fitted to the front and rear of any standard tractor, is mechanically operated by the driver from his seat. It lifts, carries and stacks as many as 40 bales in a fraction of the usual time. This process effects considerable economies and in a few minutes can save an entire field of bales from a sudden change in the weather.

TROJAN AGRICULTURAL SALES,
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Trojan Works, Purley Way, Croydon, Surrey, England.

Markets Overseas

ON A number of occasions we have emphasised the enormous potential of the overseas market, due to the chronic state of undevelopment and under-development of vast areas where populations are rising. This is the direct result of the wonderful work of World Health Organisation in fighting disease and saving millions of lives and millions of wasted hours of sickness and suffering, which can now be used, and must be used, for national development.

With British farming now the most highly mechanised in the world, business in agricultural machinery and plant is mostly on a replacement basis, and there is a real glut of secondhand tractors which have been sold by their owners in part exchange for the latest models. With the home market in a state of near-saturation, manufacturers need to turn to markets overseas to maintain their volume of output and keep their prices at a competitive level. Otherwise expressed, it is necessary to produce at a uniform rate, not only throughout the year, but also from year to year; in fact, the trend should be towards a steady increase in production if the expanding economy, on which we depend, is to be maintained.

In Britain a hot summer may be followed by a cold one, a wet year by a dry one. For manufacturers of driers, irrigating equipment and crop sprayers this would mean a succession of good years and lean years unless they have an overseas market to smooth out the fluctuations.

Similarly, when it is spring and summer in the northern hemisphere it is autumn and winter south of the equator. Thus within-the-year fluctuations in production can be ironed out by selling ploughs, cultivators and seed drills in European countries, U.S.A. and Canada in the winter and spring, and in South Africa, Australia and New Zealand in our summer and autumn. The converse applies for refrigerators, combine harvesters, crop driers and spraylines.

As regards the under-developed countries it is not surprising that the gap between them and the more highly developed countries of the West is widening, and if the uneasy peace of the world is to be maintained it is essential to help them to help themselves to produce enough food to meet the full needs of their rapidly increasing populations. We are convinced that the need for deterrent weapons, on which millions are being spent, would be less urgent if life were made more bearable for millions of people who are undernourished.

What is needed urgently are more machines and training in their correct use, and not only plans for national development, but their successful implementation. The potential of the overseas market is enormous. Always—somewhere in the world—there is a market for agricultural chemicals, farm equipment and machinery.

In the Ukraine over 3 million acres are planted to sugar-beet. Last year the collective and State farms of the Republic delivered 21 million tons of sugar-beet to the sugar refineries

Trace Elements in Russia

W. G. CASS

A LARGE and increasing amount of research on trace elements and their action on livestock and crops is undertaken in the U.S.S.R. and many papers on the subject have been read at conferences, *e.g.* Moscow (1950), Riga (1955) and Baku (1958). A comprehensive review from which these notes are taken is published in the *Mezhdunar. Sel's-kokhoz. Zh.* (Internat. Agric. Journal) and translated also in the *L.L.U. Trans. Bull.* for Feb. 1960.

The arbitrary division of plant foods into micro-nutrients and macro-nutrients is misleading—when lacking, a trace element may be of greater importance than a major element.

Application of mineral fertilisers on a vast area of sugar-beet at the Kirov collective farm in the Krasnodar area of the U.S.S.R.

These elements are being widely used on State and collective farms, *e.g.* as manganated superphosphate from the Vinnitski works and boric superphosphate from the Aktyubinsk factory. Boro-magnesian fertilisers, copper-containing pyritic ashes etc. are also available. Crops are improved both in quantity and quality. The major fertilisers, with these additions, become more effective and crops are more disease- and pest-resistant.

The trace elements must, of course, be applied with discretion and at strictly controlled rates, taking account of different soil properties, the presence of already assimilated forms of these elements, physiological features of different strains and varieties of plants and the microbiological processes taking place in the soil.

Boron—the leader

Boron is well established as one of the most important of the trace elements to be introduced with the fertiliser as a seed dressing or as a top dressing. Leguminous crops, as also flax, potatoes and sugar-beet, containing two to four times as much boron as grain crops, react thereto

Photo: J. Dunlop

Heart rot in sugar-beet. Note the development of secondary crowns and the death of the youngest leaves of the two deficient plants

very well. It plays an important part in protein and carbohydrate metabolism, as well as in pollination, and not only aids disease resistance, but also resistance to drought and high temperatures. It is specially valuable where lime is applied to acid podzolic soils; it enhances the favourable action and diminishes the effects of over liming on crops such as flax and potatoes.

Boron has a specially favourable effect on legumes—clover and lucerne seed—and, according to work done at the All Union Fodder Research Institute, with an application rate of 2 lb. per acre to podzolic clay loams to which lime has been applied, the yield of clover seed was nearly doubled. This has been also confirmed by experiments in Latvia, Moscow, Yaroslav, Gorki and other areas. The same applies to flax. On sod-gley and dark-coloured boggy soils an application of 3 lb. borax per acre with the major fertilisers improved the quality and increased yield of long fibre by 100-250 lb. per acre, and the yield of seed was also increased. Similar improvements are reported for sugar- and fodder-beets and other vegetable crops.

Consumption and application rate

In the report of the Baku conference on trace elements it was stated that the annual consumption of boron fertilisers is equivalent to 1,000 tons boron. During the next few years (1960-70) this will be raised to about 4,500 tons. The conference recommended from 0.5-1.5 kg. of boron in fertiliser (B concentration is not stated) for various crops. But methods of application must be improved and the fertiliser must be spread over as wide an area as possible, *e.g.* in top-dressing or in seed treatment, with boric acid or borate salt solutions.

Top dressing may be done with solutions of fertiliser containing 200-250 mg. per litre of boron. Some 800-1,000 litres of this solution should be applied per ha. in one or two applications. Top-dressing of the plants with boron is at the rate of $\frac{1}{2}$ lb. of *boron** per acre, and evening applications are advised. Some notes are added on recommended methods and boron concentration.

Production problems

On the production side it is apparent that the output of boron fertilisers needs to be considerably increased. The conference recommended the following: single and double borated superphosphate, precipitated magnesium borate, borodatolite (datolite zeolite), commercial boric acid, as well as compound and mixed triple and double boron-containing fertilisers. The range should include water-soluble and assimilated acid-dissolved forms. It was also proposed to introduce in 1958-60 the production of double boric superphosphate at the Krasno-Ural works and of borodatolite at the Voskresenski chemical works.

Meanwhile, the search for fresh sources of boron is to be intensified. In Azerbaijan, research into the recovery of boron fertiliser from certain waters is in progress. Other developmental work relates to improved seed dressing, spraying and dusting equipment and to the careful recording and evaluation of the results of the various research stations and experimental grounds.

Copper for boggy soils

Copper is particularly effective on boggy and other soils, that may be deficient, for stimulating enzyme activity and increasing the protein, fat, starch and pentosans content of plants, especially cereals. Other crops, too, are stimulated on a wide variety of soils. Rates of application depend, of course, on the nature of soil and the crop and may vary widely. It has been recommended that soil survey maps should indicate the requirements.

Reclamation of marshlands

The demand in Soviet agriculture for copper fertilisers is increasing considerably with the development of large areas of marshland in White Russia, the Ukraine, Baltic areas and West Siberia. Pyritic ashes (? basic slag) and other by-products containing copper as well as copper salt solutions are being used. These ashes also contain small amounts of other trace elements, such as cobalt and molybdenum. According to their copper content, they are applied at the rate of 500-800 lb. per acre, once or twice per rotation of eight to 10 crops, in autumn or spring.

***Brown heart** in swede due to boron deficiency. The same symptom is produced in turnips*

* 1 lb. Boron = 8·8 lb. Borax

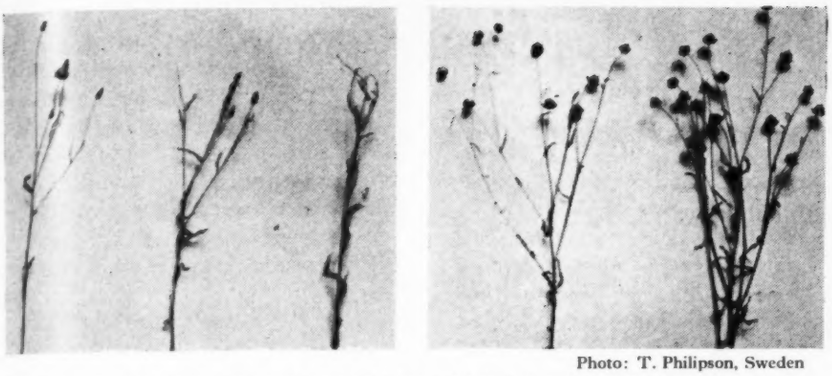


Photo: T. Philipson, Sweden

Flax: boron-deficient (left) *and normal plants* (right) *showing failure of seed production in the former*

The value of copper sulphate, too, is emphasised and it is recommended that its production should be greatly increased. The average application is 20-25 lb. per acre. Wet dressing of seed with copper sulphate solution, using a strength of 0.001-0.005%, is also becoming a common practice; or the seed may be sprayed. When properly used, good results are often obtained. With soil blocks made of a peat-compost mixture, copper is added at the rate of 0.2-0.5 g. per cu. m. of mixture.

Manganese for metabolism

Manganese has important physiological effects and promotes increased activity in enzymes associated with respiration, photosynthesis and nitrogen metabolism. Manganese fertilisers are being used to increase the yields of sugar-beet, cotton, wheat, maize, vegetables and other crops, especially in the Ukraine, Azerbaijan, Georgia and Central Asia, on slightly leached black earths, the grey forest soils—solonetz (dark and strongly alkaline)—and the chestnut soils, as well as other soils containing little available manganese.

The fertilisers used may either be in the form of sulphate or they may be by-products from manganese ore smelting that do not require grinding before use. There are also the tailings from the Nikopol, Chiatur and other deposits, and manganese sulphate produced as a by-product of the Azerbaijan oil industry. Other industrial sources are the concentrated sulphate solutions from chemical works (*e.g.* Krazny Khimik, near Leningrad) and granulated manganous superphosphate.

Rates of application and methods of use are described and favourable results are recorded for sugar-beet and wheat in the Ukraine, and for crops grown on the chestnut soils of Azerbaijan, *e.g.* cotton.

Promoting nitrogen fixation

Molybdenum is valuable, among other things, for promoting nitrogen fixation by stimulating nodulation in the roots of leguminous crops. It takes part in nitrate reduction in the plant and enters into the composition of the enzyme nitrate reductase. Molybdenum is particularly effective on acid sod-podzolic soils containing large amounts of free aluminium and manganese. In such soils, molybdenum is to be found in small amounts and in a form which is not readily available to plants.

The results obtained show that a top-dressing of molybdenum to clover and other perennial legumes on these soils is one of the most important means of increasing yields and protein content. It also has a similar effect on hay and on grass seed. Experiments in Latvia in 1958 are described, wherein top-dressings of a solution of ammonium molybdate were applied by tractor sprayers to large areas under clover. With concentrations of 100 g. in 400-600 litres of water, crop increases ranged from 20-40% and for the seed from 10-30%. Maximum benefit was obtained from acid soils (of *p*H 4 or 5). The pea crop also benefited greatly.

Molybdenum can be applied in the superphosphate form at the time of sowing. The recommendations of the Gorki Agricultural Research Station, based on extensive experimental work, are given in detail for the use of molybdenum as a trace element for hay and seed of various leguminous crops. These include wetting seed with molybdenum solution some months before sowing and also top-dressing or spraying of seedlings. The prepared seed is treated with 'nitragine' in the usual way.

The Baku conference strongly recommended increased production of granulated molybdenated superphosphate for further extensive trials. The discovery of rich deposits of molybdenum ore in various parts of the Soviet Union in recent years should facilitate greater production and wider use in agriculture.

For fruit crops

Zinc is not only of value in fruit cultivation, but also with most agricultural crops. The content of free zinc in the soil depends on organic matter present and on acidity. It may be used as a basic fertiliser in the soil, as a top-dressing and in wet-dressing before sowing. The following rates of application of zinc sulphate are suggested: 5-10 lb. per acre in 0.01-0.02% concentration for top-dressing; 8-10 litres of a 0.03% solution per 100 kg. of seed for wet-dressing; and 1 g. per cu. m. of peat-compost mixture for soil blocks. Possible sources of supply and the action of zinc in association with other trace elements are among the subjects for further study.

Cobalt in recent years has also been found to be of value in agricultural production, but no details are given in the review. This is a trace element of considerable importance in livestock nutrition, as is generally well known.

Photos on pages 250 and 251: Borax Consolidated Ltd.

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

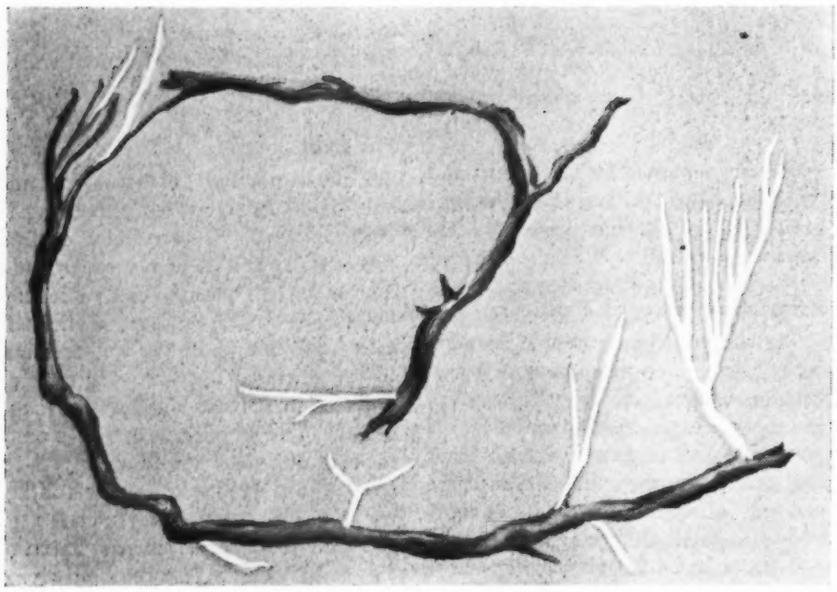
A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

Imperata Cylindrica

A Curse of Tropical Agriculture

F. C. COOKE,* A.R.C.S., B.SC., A.M.I.CHEM.E.



A 3-ft. length of coconut root completely smashed and destroyed by illuk. About 30 ft. of root and rootlets are cut off in this way

Variously called lalang in Malaysia, Tanganyika and Kenya, illuk in Ceylon and cogon grass in the Philippine Islands, this rapidly-spreading plant is a dominating and destructive weed which is very difficult to control or eradicate.

MOTHER NATURE in her lavish way allows plants and animals of many kinds to grow in association and to compete for water, food, life and light, according to the law of the survival of the fittest. Man, in developing the art and science of farming to meet the needs of ever-increasing numbers, is coming into increasing conflict with nature. In his desire to obtain higher productivity per acre he puts large areas under a single crop, which he endeavours to protect as effectively as he can from competing forms of life.

A given area cannot support an unlimited number of plants, and if a crop is correctly spaced it is necessary to keep under effective control or to eradicate competing plants, particularly where one of these is likely to become dominant. In the rainy tropics the most dominant and destructive weed is the erect, coarse grass, lalang, *Imperata cylindrica*, which flourishes on the more fertile soils in the absence of shade to check its growth. In pasture areas free-grazing cattle will feed selectively, consuming the more succulent growths and leaving the harsher lalang and the shrubby weeds to spread and multiply, but ultimately even these shrubby weeds will be suppressed by the more dominant lalang.

This happened during the Japanese occupation of Malaya between 1941 and 1945, when the Chinese growers abandoned their pineapple fields and took refuge in the jungle. A mixed flora of weeds and shrubs developed at first, but ultimately lalang became dominant, forming a vast green sea, stretching for miles, for long regarded as spoiled and unusable land. Today, by modern methods, such areas can be converted into useful pastures and so provide milk and meat for the rapidly growing population of that country.

Research in Malaya

Before the war the effect of this weed on young rubber and young coconuts was studied in Malaya. Up to then it was believed that some toxic substance in the lalang affected the surrounding vegetation and that its matted root system choked out other plants and prevented soil ventilation. The experiments showed that one reason for its adverse effects on large plants and trees was root destruction, and on surface-rooting plants it was its overwhelmingly more rapid rate of growth and its spreading habit, which is similar to, but far worse than, couch grass.

Lalang spreads very rapidly once it has been introduced, partly through its prolific seeding, partly by the rapid spread of its underground runners or rhizomes, and partly by the fact that the effect of cultivation is to produce more plants, as each piece of broken root will produce a fresh head of grass, which in favourable conditions will grow to a height of 3 or 4 ft. Its root system forms a mat of thick rhizomes and tiny rootlets just below the surface which effectively blankets the root systems of the deeper-rooting plants, such as coconuts, rubber and pineapple, and prevents air and water passing down to lower levels.

Each of the major stems, or rhizomes, has a sharp, unyielding bayonet point and a single plant will have a number of these points, which will seek out the weaknesses in the major roots of adjacent plants. The underground stem can even penetrate the hard, protective covering of a major coconut root and pass along it

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for 1 or 2 ft. As the rhizome swells the coconut root bursts longitudinally and the bayonet point emerges to send up a fresh head of grass; water is let in and the tissues of the damaged root rot and die. This means that the whole of the system of major and minor roots below this point are cut off from the plant, and thus a single penetration may destroy many feet of root and root hairs.

While full-grown mature coconut, rubber and cacao trees, if correctly spaced, do not allow the weed to grow in their dense shade, this is not the case with young plantations and generally there is adequate light for lalang to grow prolifically. Young coconut palms, growing in association with this weed, become yellow and the leaves will be short and first crop production will be delayed for two or three years or more; in extreme cases the plant will be overwhelmed and die.

In this way the unchecked growth of this weed may do serious harm to tree crops and may overwhelm surface-rooting crops like pineapples, cereals and pasture grasses. So prompt action needs to be taken to keep it under control before it can get itself established, for if it is left too long its eradication becomes progressively more difficult, expensive and laborious. Its wind-blown seeds are free to spread far and wide over adjoining properties from a single neglected piece of land on which it has become established.

Methods of control

Various methods for its control are practised. Burning is the commonest and most disastrous method of all, as the underground rhizomes are not destroyed and the new growth will come up as an even more pure stand of lalang, assisted by the growth-promoting ashes of all the plants destroyed by the fire. One effective method of control is to cultivate to a depth of 9 in. and remove each fragment of rhizome, piece by piece, by hand, but this is only practicable for small areas and is far too costly on plantations, although it is sometimes practised, though rather ineffectively, as it needs to be regularly repeated.

Another method of control is by ploughing, whereby the clods are turned over and the underground stems are exposed to the sun. Repeated ploughing also destroys the green leaves so that the food reserves of the plant are gradually depleted. The same effect can be obtained by mowing where this is possible and by grazing the new young growth with cattle. This method, too, is only of limited application.

Another method is by the use of cover crops. As already stated, the weed does not like shade, and where quick, vigorously growing covers are planted the lalang can be suppressed. But the cover, too, needs to be controlled and should be low-growing, because the coconut crop cannot be collected satisfactorily if the cover is allowed to become too high. Furthermore, in areas of low rainfall the cover crop will compete actively with the palm for the available moisture.

In recent years the high cost of hand weeding has led to the increasing use of chemical methods of weed control. Arsenic, for instance, can be used satisfactorily against lalang, but it has to be used with great caution owing to its highly poisonous character.

Trials with various kinds of herbicides are in progress at the principal crop research stations and in Kenya and Tanganyika, in particular, small plot experiments are being used to evaluate various treatments and compare their cost (see p. 268).

Finally, it would appear that a satisfactory method of mechanised weed control has at last arrived. The recent introduction of the new Peter Standen 'Vibro-Rota' tiller, which was originally developed for seedbed preparation after the plough, has produced the surprising discovery that it will bring underground roots, such as couch and willow weed, to the surface of the seedbed, where they can wither away and die through the action of the wind and sun.

Mechanical weed control

The 'Vibro-Rota' tiller is a simple combination of a vibrating spring-tine harrow and a rotary cultivator, which in one or two runs can render down soil of any texture to a fine tilth ready for seeding. It can thus be used not only for weed eradication, but also to cultivate the rows between young tree crops and to convert the vast areas of lalang found in the tropics into properly seeded pasture and clean arable land.

With the new 'Vibro-Rota' tiller a seedbed can be made from ploughed land in one operation. Any root rubbish, such as lalang or couch grass, is worked to the top and left on the surface

The Rambutan

J. N. MILSUM,* F.L.S.

This is a short account of recent work† in the cultivation and propagation of a luscious tropical fruit which is almost unknown in Western countries.

DURING the past two decades the rambutan has been increasingly planted in Malaya and since propagation of clonal material by budding started in 1932, the demand for nursery stock has increased. After independence in Malaya fruit has been given higher priority status and the supply of clonal material is now on a commercial basis.

A commercial orchard of eight-year-old rambutan trees in Malaya

Distribution

Rambutan is a native of Malaysia and is grown throughout the Malay archipelago and surrounding countries. It is estimated that the acreage of rambutan in Malaya in 1958 was 24,000 acres, 67% being mixed cultivation, with 8% as the main or dominant trees, and the remaining 25%, or about 6,000 acres, as a sole crop.

In addition to distribution of young trees bud-grafted with clonal material from agricultural stations throughout the Federation, there are two commercial fruit nurseries in Perak producing bud-grafted plants. These nurseries are now selling some 6,000 bud-grafted plants per annum. Since rambutan is a fruit popular throughout the Malay Peninsula and surrounding territories, the increasing attention being given to this fruit is considered most opportune.

Opportunities for improvement

Although rambutan is so well known in Malaya, it still provides a wide field for investigation. Selection of varieties and their increase, nursery technique and the behaviour of budded stocks are of importance. This might lead on to trials with selected varieties budded on stocks produced vegetatively, as is used with temperate fruits. Whilst clonal trees should be advantageous in village orchards composed of mixed fruits, their use in planned commercial plantings may open up economic possibilities.

Rambutan is seasonal, fruiting in two main seasons, between June and September, and between November and January. With a perishable crop local gluts may be eased by improved distribution and possibly by preserving. Certain varieties have shown suitability for canning and canned rambutan might prove acceptable in overseas markets. An allied fruit, *Nephelium litchi*, is already successfully canned and exported from China.

Botany

The rambutan, *Nephelium lappaceum*, belongs to a genus of the family Sapindaceae, of which some 16 species inhabit the lowland forests of Malaya. In flower and foliage the species are much alike, but are readily distinguished by obvious characters. The cultivated rambutan has fruit differing from those of its wild allies in that good forms have fruit with plump, sweet, separable flesh without adhering testas.

The name rambutan recalls the Malay word 'rambut', meaning hair, and the specific name 'lappaceum' signifies in Latin the resemblance of the fruit to a 'burr'. The fruit is about 2 in. in size, round or oval, with soft hair-like spines on the surface of the rind, in various shades of red or yellow. The large seed is surrounded with white or yellowish pulp. This is transparent, sweet and juicy, varying in thickness and quality.

A tree in fruit is a conspicuous and beautiful object, the fruits looking like hanging strawberries. The cultivated rambutan has male and female flowers on the same tree, but dioecious forms exist. Rambutan, which is one of the best known fruit trees of the East, is of medium size with a dense head of branches.

Seedling trees have a straight trunk and in village orchards, where trees are often overcrowded, may not fruit for many years, whereas when conditions

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† *Malayan Agricultural Journal*, 1959, **42**, No. 2, 'The Rambutan' by C. Whitehead; 'Commercial Fruit Nurseries in Perak' by T. R. Dickinson.

are suitable they fruit in six years. Many of the orchards formed from marcotted or air-layered plants are more compact in growth than seedlings, with low spreading branches reaching the ground. Such trees may start bearing when two years old. Seedling trees show much variation in fruit. The poorest have thin, dry, insipid flesh, inseparable from the seed, and the best have large, plump fruit, with sweet, separable flesh. The colour varies, the commonest being crimson, but sometimes yellow; such races are usually of more uniform quality.

The fruits look like hanging strawberries

Propagation

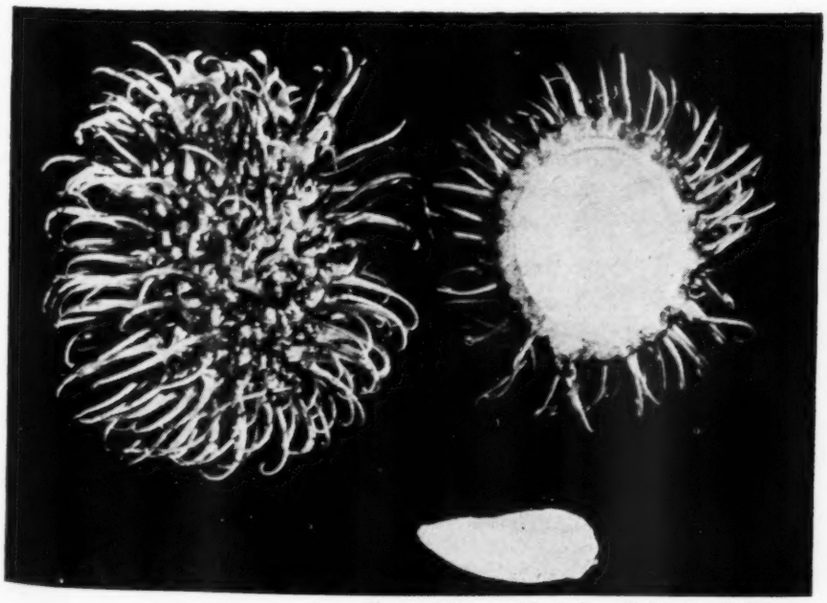
Since cross-pollination is usual, seedling progeny are variable in quality. Vegetative propagation has been done for many years and more than 50 years ago there were numerous orchards of marcotted plants, usually belonging to Chinese growers. As facilities for transport increased, distribution became more general and the demand for clonal material became marked. Budding started about 1932 with material selected from orchards in Penang and Selangor. The modified Forkert method of budding proved successful and considerable numbers of budded trees were distributed before the Japanese invasion.

Varieties

Of the many varieties selected before the war, 21 were traced by the Department of Agriculture in 1946 and with further selections made since then 32 varieties are now registered. These selections are based largely on fruit quality and field trials are necessary to provide additional information regarding yield and behaviour. Eleven of the more important varieties are described and distinctive characters as regards appearance of foliage and fruit, quality and flavour, size of seed, freedom from adhering testa and suitability for canning recorded. The data obtained provide a basis for assessing comparative values for field experiments.

Trials conducted in Selangor and Perak with budded varieties planted in 1948 have been undertaken to provide data of relative fruit quality, flowering and fruiting dates, vigour and commencement of bearing. Results over the 10-year period are now available. This is the first large-scale trial recorded in Malaya, which, however, must be viewed tentatively as covering the specific conditions of the trials only during the first 10-year period.

Earliness of bearing, yields and fruit quality provide useful comparisons between 13 established varieties. Since open-pollinated seedlings from mixed mother trees were used as stocks, it is emphasised that such rootstocks of variable genetic origin may seriously affect individual tree behaviour. Whether clonal rootstock material may become available is a matter for further enquiry. Conditions in the tropics are not comparable with those in temperate regions and modified techniques are likely to be necessary.



Photos: Ministry of Agriculture, Federation of Malaya

The hairy rambutan fruit is about 2 in. in size, red or yellow, and round or oval in shape. The seed (bottom right) is surrounded by a white or yellowish pulp, which is edible

Commercial nurseries

The early success obtained with distribution of budded fruit trees induced the Department of Agriculture to encourage commercial production. The demand for clonal bud-grafted trees, principally rambutans, increased

(*Continued on page* 264)

Lantana Bug

Introductions into some Pacific Islands

R. J. A. W. LEVER*

Lantana camara is a troublesome shrubby weed of the humid tropics

Teleonemia lantanae (× 20)

A PREVIOUS article (WORLD CROPS, 1960, **12**, 57) showed that the results of the introduction of the lantana bug into Kenya (and later into Zanzibar) had so far given somewhat disappointing results in the control of this rapid-spreading weed. If reference is made to the various accounts of the introduction of this insect, *Teleonemia scrupulosa*, from its original home in Mexico into the Hawaiian islands in 1902, to Fiji in 1928 and various other Pacific islands between 1937 and 1940, there should be no surprise at its initial failure in Africa.

As the writer was responsible for the breeding and release of colonies of this bug after it became established in Fiji, it may be of some value to deal briefly with the work carried out in the Pacific in the hope that it may prove useful for comparison with the much more recent East African releases.

Teleonemia belongs to the same family, the so-called lace bugs, as the rhododendron bug of Britain. Both have a raised network on the wings and both lay their eggs inside the leaf midrib of their respective host plants. The injury caused by the bugs differs, as *Teleonemia*, by sucking sap from the leaves, flower buds and stems, causes withering and subsequent shedding of the leaves, failure to produce flowers or set seeds, thus resulting in the checking or death of the lantana. It was the general experience in all the islands—Hawaii, Fiji, New Caledonia, the New Hebrides, Western Samoa and Tonga—that it was only in the dry zones or during periods of relatively dry weather that the bug made much headway in checking lantana, which managed to outgrow the damage during wet weather. This fluctuation could, of course, be expected when one considers the almost arid conditions of its original home in Mexico.

Two points are worth mentioning from Fiji: firstly, that the presence of predacious bugs on the lantana caused a severe check to *Teleonemia* in the egg and young stages, and, secondly, that it has been found necessary to introduce other Mexican insects via Hawaii in order to bolster the bug and other insects brought in over 30 years ago. Hence it seems a reasonable forecast that in Zanzibar, and perhaps also in Kenya, not too much hope should be placed in the control exercised on the spreading lantana menace by the bug *Teleonemia*.

Illustrations: M. J. L.ver

Left: *Healthy plant of lantana camava.* Right: *Attacked shoot*

* Formerly Senior Entomologist, Department of Agriculture, Malaya.

Timber for Agricultural Buildings

W. P. K. FINDLAY, D.SC.

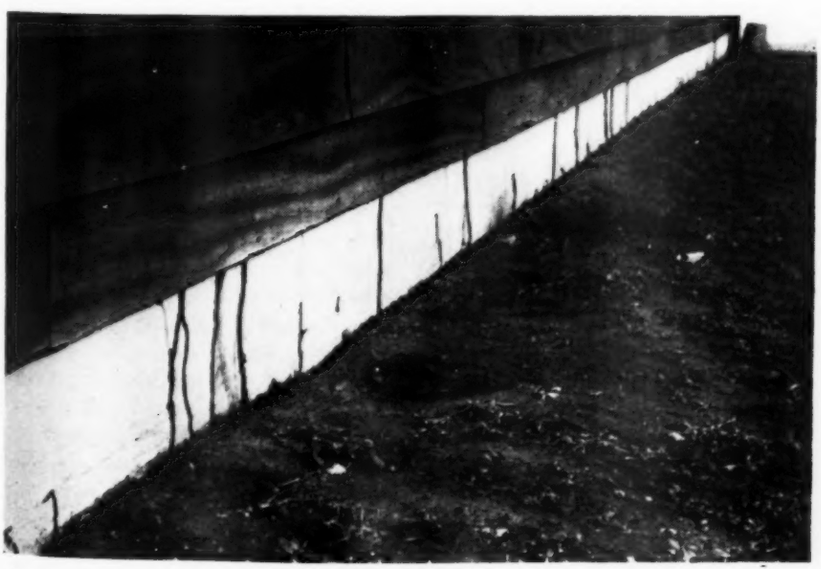
FROM time immemorial, timber has been the traditional material for the construction of agricultural buildings, and many fine examples of medieval tithe barns can still be seen in England. In many of these one may find beams half-eaten away by woodworm, but still of sufficient strength to support the loads they bear. They have endured because the beams were of large size and fashioned from oak, a durable timber.

Timber is still the most suitable and adaptable material with which to build many types of farm buildings, but it can no longer be used as extravagantly as in those days, as the supplies of durable timbers are not inexhaustible. By skilful design, roofs of adequate strength can be built of small pieces of wood, glued or fastened together with metal connections, so as to form rigid members or trusses of the required strength, but this cannot make allowance for dimensional changes through fungal decay or insect attack.

Tanganyika. An apparently sound roof beam of an old building in Dar-es-Salaam, exposed and shown to be hollow and dangerous.

Need for treatment

Since few of the lower-priced woods now available in Britain are sufficiently durable, it is important to give them effective treatment with wood preservatives. Even in the less industrialised countries, such as New Zealand, South Africa and East Africa, supplies of naturally durable woods are running out and are being replaced by quick-growing exotic species of eucalyptus or pine. Fortunately, effective methods of treating such timbers so as to make them almost as durable as the more expensive hardwoods are now available.



Ghana. Covered runways of ground-dwelling termites passing up over the surface of the concrete formation of a wooden building.

Classification by durability

For building purposes one can classify timbers on a basis of durability into four groups, but, of course, the durability of a particular timber may vary within quite wide limits, depending partly upon the age of the tree from which it was cut and partly on the particular pests or fungi that may infest it. The following is a durability classification:

(1) *Very durable woods* that can be used in direct contact with the ground and can safely be exposed to termite attack.

(2) *Durable woods* which will give long service when used in exposed parts of buildings not in direct contact with the ground.

(3) *Moderately durable woods* that will last many years if protected by paint or shielded against penetration of dampness or access of termites.

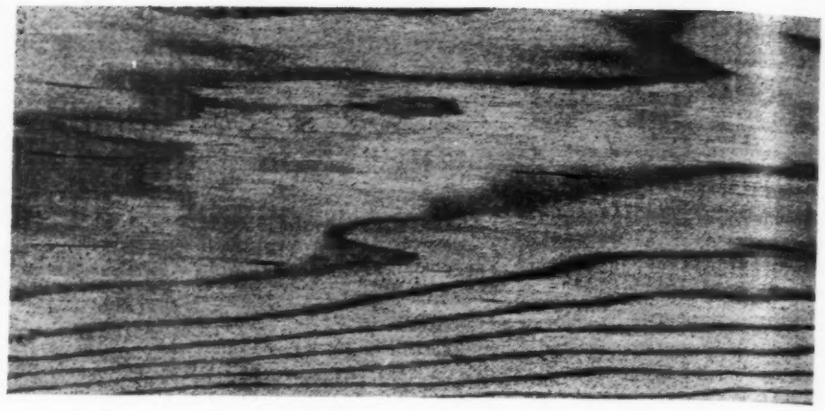
(4) *Non-durable and perishable woods* that should never be used in any permanent buildings without preservative treatment.

Naturally, the risk of decay and insect damage varies according to the

type of building, the use to which it is put and the climate to which it is exposed, but it is always desirable to take precautions against premature decay.

In trees where there is any distinction between sapwood and heartwood the sapwood—that is, the ring of pale-coloured wood immediately below the bark—is always more susceptible to decay and to insect attack than the darker-coloured heartwood.

Information about the properties and availability of local kinds of timber can usually be obtained from the Forestry Department of the territory, and the list of timbers given in Table 1 gives some indication of the types of wood that fall into the four classes listed above. It is by no means a complete list.



Douglas fir, Pseudotsuga taxifolia, *a softwood immune to certain types of wood borer beetle attack, but otherwise its standards of resistance to either fungal or insect attack are only moderately good*

Protection against dampness

No untreated timber, unless of a very durable species, should be allowed to come into direct contact with the ground. When a wooden building is erected on brick or concrete foundations or piers it is always advisable to insert some form of damp-proof course between the brickwork that is in contact with the damp soil and the woodwork above. Good-quality bituminous felt or a layer of slates will prevent the capillary rise of soil moisture through brickwork, masonry or concrete.

When the building stands on brick or concrete piers in termite-infested soil a metal termite shield should always be fixed around the piers to discourage earth - dwelling termites from building their runways up them. However, one can never rely completely on these shields, so it is always wise, when building in such conditions, to treat all structural woodwork thoroughly with a wood preservative before it is built into the house.

Selection of timber

Timbers of the durable class should be used for sills, half-timbering wall plates and thresholds etc. Timbers of the moderately durable class can be used for carcassing and flooring, while certain non-durable woods may be suitable for joinery in areas where there is no risk of termites.

Many factors in addition to durability must be considered when selecting timber for a building—*i.e.* strength, possibility of seasoning without distortion, ease of working and the ability to take nails without preboring.

It is not essential that a timber should possess great inherent strength for it to be satisfactory for constructional work. With a few exceptions, any ordinary timber can be used for building purposes, provided it is used in appropriate sizes. If the working stresses required are known and the average bending strength of the species is also known, it requires only a simple calculation to determine the dimensions and spacing of the structural members.

If a builder has to use a timber that is less strong than the one to which he is accustomed, he must increase the dimension of the members —if one that is much stronger he may safely decrease them. For example, if he is accustomed to using 2-in. x 4-in. joists of Baltic redwood, he may safely use $1\frac{3}{4}$-in. x $3\frac{1}{2}$-in. of Douglas fir. It is, however, important to use for joists and rafters, timbers that possess adequate *stiffness* so that undue deflection does not occur when the members are stressed by the dead loads that they may have to bear.

Uniform strength essential

Uniform mechanical properties within a consignment of timber is even more important than the absolute strength values. If within a parcel of timber there are pieces varying in strength from 500-1,500 lb., the architect will have to allow such a wide margin of safety that he will use the material more extravagantly than if the material is so graded that no piece in the parcel has a lower strength than 800 lb. For the most economical use of timber as a structural material some degree of strength grading is therefore essential.

The principal features that influence the strength of a timber are its density, straightness of grain and absence of knots on the compression and tension faces. In certain tropical hardwoods the centre portion of some logs contains wood of inferior quality which is extremely brittle. Such 'brittle-heart' timbers, which often also exhibit transverse fractures, called 'thunder-shakes', must be rigidly excluded from all structural work.

The ease with which the timber can be seasoned without distortion is most important when the wood has to be used in small dimensions, *e.g.* for glazing bars in a window and for joinery such as doors that have to fit closely. For large timbers, such as posts, distortion on drying is less likely to occur and when it does is less serious.

Table 1

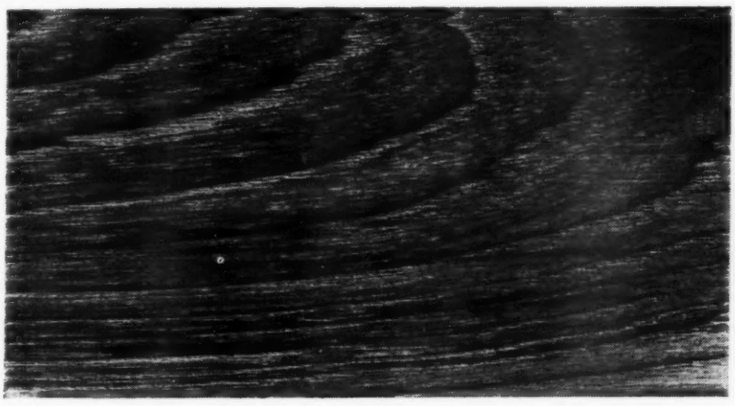
Classification according to durability

Very durable	*Durable*	*Moderately durable*	*Non-durable*
Teak	Agba	African mahogany	Spruce
Greenheart	Oak	Sapele and utile	Henbeck
Iroko (muuli)	Jarrah	Douglas fir	Saligna gum
Ekki	Pitchpine (long leaf)	Larch	Abura
Okan	Kapur	Keruing	Obeche
Opepe		Meranti	Poplar

Ease of working important

Ease of working is essential when buildings have to be erected without power tools. Under factory conditions it may be possible to pre-bore holes for fixing and screwing together of members in prefabricated buildings, but when the timbering is constructed on site with hand tools the timber must be reasonably easy to work. Many excellent woods, although possessing high strength and great durability, are valueless for building purposes if they cannot be worked without excessive expenditure of human energy and time.

When, after the war, softwoods were in short supply in England one of the difficulties that was experienced when using tropical hardwoods for building purposes was this problem of workability. Joiners accustomed to handling easy-working softwoods resented having to work with refractory hardwoods into which nails could only with difficulty be driven. Only woods such as abura, obeche, afara and some of the lighter Malayan hardwoods were favourably received for general carcassing and light constructional work.



Teak, Tectona grandis, *a very durable timber. The heartwood is markedly resistant to all types of wood-destroying agent*

Seasoning of timber

Except for very rough work, timber for the structural parts of a building must be seasoned, *i.e.* dried down to equilibrium with the atmosphere, before it is used. There are two main reasons why it is unwise to use timber in a green, unseasoned condition. Firstly, it will probably go mouldy and stain, or it may even decay before it dries out; and, secondly, it will certainly shrink when it does eventually dry out, and then all the joints will open up, gaps will appear between the floor boards, and doors and windows will cease to fit.

Immediately after a log is sawn up into boards, planks or dimension stock the pieces should be piled to season, with piling sticks between each layer of boards, each piece being aligned above the one below. The piles, which should be on solid foundations raised about 18 in. off the ground, should be not more than 6 ft. wide and should have some form of roof to throw off the rain. The ground around the piles should be free of weeds and rubbish which might interfere with the flow of air through and around the piles.

The time required to season timber depends on the kind of wood, the thickness of the pieces and the atmo pheric conditions. Boards of pine 1 in. thick may be fully air dried in a few months, while oak 4 in. thick may not be completely seasoned even after five years. When dealing with native timbers experienced woodmen should know how to handle them, but advice should be sought on the seasoning properties of unfamiliar imported woods. Canadian hemlock, for instance, is often exported in an unseasoned condition and, since it dries much more slowly and irregularly than most softwoods, special care must be taken to ensure that it is fully seasoned before use.

Preservatives used

There are now available in most parts of the world highly effective wood preservatives. Before deciding which preservative to use some thought should be given to the following points:

(1) Is the wood to be exposed to the weather?

(2) Is the timber to be painted?

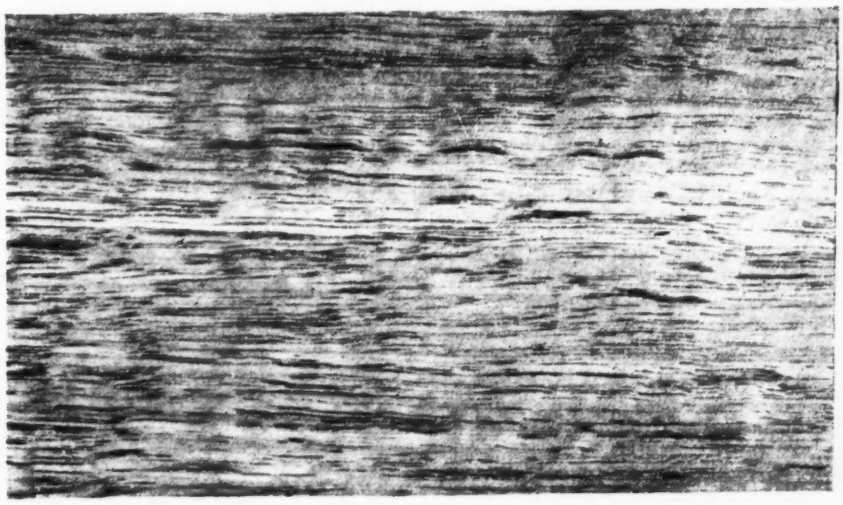
(3) Is the treated timber likely to come in contact with

(*a*) Foodstuffs that may pick up taint?

(*b*) Plaster or paint that may be stained?

(4) What methods are available for applying the preservative?

In order to get effective and long-lasting protection against rot and insect attack it is absolutely essential that the preservative should penetrate deeply into the wood. It is not necessary for the wood to be treated right through, provided that there is a zone of treated wood on the outside deeper than any splits or cracks that may subsequently open up. But it needs to be



Jarrah, Eucalyptus marginalia, *a durable timber which has the reputation of being extremely resistant to all types of fungal and insect attack*

emphasised that merely brushing a wood preservative over the surface is practically useless for timber that is to come in contact with the ground, or for timbers that are not accessible and which cannot be treated again at intervals.

Types of wood preservatives

Tar oils

Creosote derived from the distillation of coal tar has been used successfully for over a century for the preservation of timber in contact with the soil, such as railway sleepers and poles, but, on account of its smell and its tendency to 'bleed' through paint or into plaster, its use on buildings is generally restricted to foundation timbers, external weatherboarding etc.

Water-soluble salts

Water-borne preservatives, consisting of a solution of salts that are toxic to wood-destroying fungi and insects, have long been used for the preservation of timbers under cover and not exposed to the washing action of rain. Soluble fluorides, silicofluorides, arsenates, borates and salts of copper and mercury have been used with varying degrees of success.

The usefulness of such preservatives as these was greatly extended by the important discovery that the addition of chromates will fix certain metallic salts in the wood—notably those of copper and arsenic—so that once the solution has penetrated the wood these toxic elements are deposited therein in an insoluble form that cannot be washed out. Wood impregnated with such preservatives will last for many years, even if fully exposed to the leaching action of tropical rains. Salts of this type are available in many countries under such trades names as 'Ascu', 'Boliden', 'Celcure', 'Greensalt' and 'Tanalith C'.

While impregnation under pressure with salts of this type undoubtedly confers the best protection for external woodwork in contact with the soil, long-lasting protection against fungal and insect attack can also be obtained for timber that is not to be fully exposed to the elements and does not come in contact with the soil by steeping the pieces, after they have been cut to size, in a strong solution of 'Timbor', a borax-boric acid mixture, or a 5% solution of 'Santobrite', sodium pentachlorophenate.

Solvent-type preservatives

Solvent - type preservatives are chemicals that are toxic to fungi and insects, dissolved in a petroleum oil. The chemicals most commonly used for this purpose include pentachlorophenol, copper naphthenate and monochlornaphthalene and the solvents used range from a light solvent, such as solvent naphtha or white spirit, which will dry off quickly, thus allowing the treated wood subsequently to be painted, to a heavy diesel or fuel oil. Light oils are generally used when the preservative is to be used on timber for joinery etc. and heavy oils for external woodwork, such as fencing.

These preservatives are often applied by brushing, but when so applied they sometimes fail to give adequate protection because insufficient preservative is absorbed. When brushing on a preservative at least three full-flowing coats need to be applied, allowing time for one coat to dry off before the next is applied. Whenever possible, brush applications of preservative should be repeated every five years.

The price of such preservatives depends to some extent on the local availability of petroleum products. The price may be reasonable in the U.S.A., but costly in more remote regions.

So, generally speaking, in the less highly industrialised countries which do not possess chemical industries, and in which the transport charges on imported materials are high, it will be found more economical to import water-soluble preservatives in solid form and to prepare the aqueous solutions on the spot.

Use of plywood

Before the invention of synthetic resin adhesives, plywood, bonded with protein glues could be used only in permanently dry situations, and even then it was often liable to become infested with woodworm. With the discovery of glues that are resistant to moisture plywood can be made so that it will not delaminate however long it remains under moist conditions. If, however, the veneers used for making the plywood are cut from a non-durable timber (and most of the woods, such as birch and gaboon, used for making plywood are not naturally durable), then the plywood may decay in exactly the same way as the solid timber from which it was made.

In practice, this means that before one uses plywood in any position in which it is likely to be attacked by fungi or insects it must be thoroughly treated with a wood preservative or else made from veneers of some naturally durable wood. Preservation of plywood can be most effectively carried out during its manufacture, and there are now available on the British market plywoods sold under proprietary names, such as 'Celply', 'Permaply' and 'Tanply', that are effectively protected against decay.

Summing up

Buildings constructed wholly or partly of timber can endure indefinitely provided (1) they are well designed, (2) the vulnerable parts are made of durable or treated timber and (3) they are reasonably well maintained.

Millions in Forestry

The U.K. Forestry Commission, which has received Exchequer grants of £108 million since 1919, has created assets now valued conservatively at £140 million. The bulk of this is represented by new forests, not yet mature, which are increasing in value each year, according to the Commission's annual report. This states that the yield from the woodlands has already totalled £27,700,000 and that the annual income is now £2,200,000, with the prospect of a considerable increase in a few years' time.

The Commission defends the large-scale planting of conifers. It refutes the suggestion that there is prejudice against hardwoods and says that where hardwoods made a worthwhile crop they would be planted.

The Commission's estates in England, Wales and Scotland now total 2,403,000 acres.

Maize Machinery

There is an error in the account of the Budapest Exhibition in our March issue.

The new silage harvester, Type US-1,2, exhibited by the Mechanical Handling Works of Hungary, has a cutting width of 4 ft. and not 2 ft. as stated in the text. The error is regretted.

Rust Disease of Coffee

3—Resistance

R. W. RAYNER, B.A., A.I.C.T.A.*

This important paper is an example of international co-operation in research. The results of this work are of tremendous importance to the coffee industry, but they are also of immense interest to botanists and pathologists working on similar problems on other crops.

MARSHALL WARD (*circa* 1880) was the first to look for coffee varieties resistant to rust. In part he was investigating the idea that the disease was due to the effect of soil conditions or some factor peculiar to Ceylon. He accordingly imported plants from other countries and found that if he inoculated them they, too, became diseased. He carried out tests on a wide range of both local and imported varieties and found he could produce a rust attack on all of them. Fortunately, his conclusion that all types of coffee are susceptible has not been borne out by later observations.

Early observations

In 1912 it was observed in the Belgian Congo that the Liberian species of coffee (*Coffea liberica* Bull. ex Hiern) was much less attacked by rust than Arabica coffee (*C. arabica* L.). In the following year it was reported that the local native coffee of Uganda, *C. canephora* Pierre, which has become generally known as Robusta† coffee, was also less susceptible than Arabica. In consequence these two species of coffee were imported into the various coffee-growing areas of the East, in particular Ceylon and Java, where their resistance to rust was confirmed.

Now hardly any Arabica coffee is grown in Java, Robusta and Robusta hybrids having replaced it. In Africa Arabica is grown at the higher altitudes, but at the medium altitudes Robusta is now exclusively grown, whilst at low altitudes forms of *C. excelsa* and *liberica* are cultivated to a small extent. Unfortunately, the quality of the liquor which the latter species produces is considerably inferior to that from Arabica. In the New World, to which rust has not yet spread, most of the coffee grown is of the Arabica species.

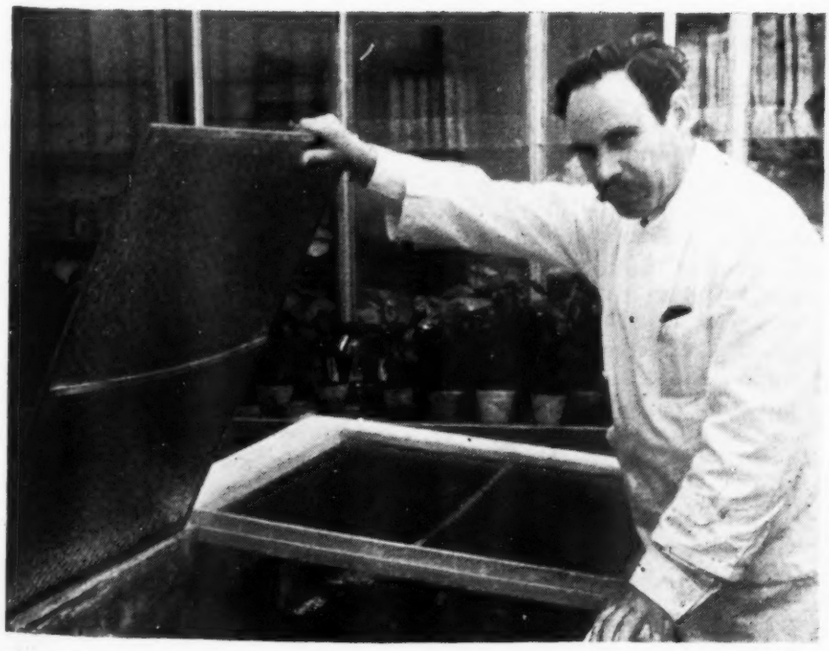
Photo: FAO

A young coffee plant in Costa Rica

Up to the last war the emphasis in the search for resistance to rust was on the non - Arabica species and on attempts to improve the quality whilst retaining resistance to rust by hybridisation with Arabica. By and large, this work was not particularly successful, as, due to the genetic constitution of Arabica, it was difficult to get it to produce fertile and stable hybrids with *C. canephora*, *C. excelsa* and *C. liberica*. A few do seem to have arisen, however, and may be of considerable value. In recent years considerable attention has been paid to examining the material available within Arabica itself and some valuable resistant varieties have been found.

Indian investigations

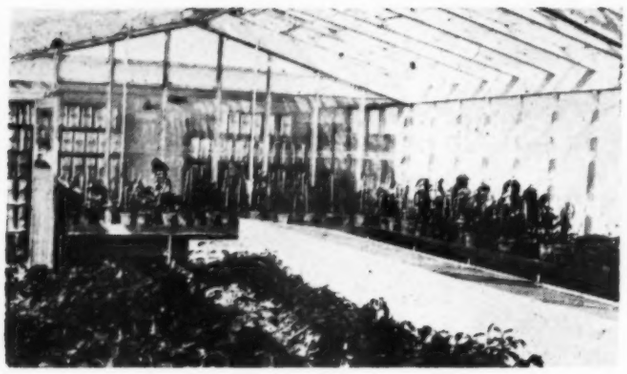
Between the two world wars it was in Southern India that the greatest advances were made, largely as the

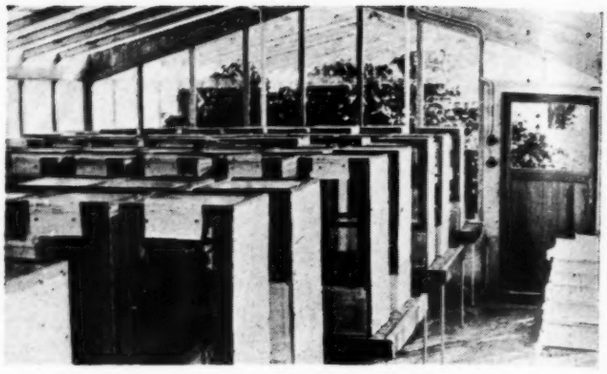


Dr. D'Oliveira inspecting plants at the Coffee Rust Research Centre, near Libson, Portugal

* Commonwealth Mycological Institute, Kew, England.

† 'Robusta' is used in this paper to include *C. canephora*, *C. congensis* and *C. ugandae*.





Left: *The collection of coffee varieties and* right: *The collection of rust cultures at the Coffee Rust Research Centre near Lisbon, Portugal*

result of investigations by W. W. Mayne.[8, 9] The early types of Arabica coffee planted in Mysore were very susceptible to rust and therefore ceased to be cultivated. One variety found in the Province of Coorg was, however, resistant and this 'Coorg' variety became widespread. Towards the end of the century it, too, was attacked by rust, but a form on an estate belonging to a Mr. Kent was found to be resistant and this 'Kents' variety, in turn, was widely cultivated.

Mayne investigated the reason for the apparent lack of resistance of certain varieties. He developed a technique in which individual leaves of the different varieties were kept in moist chambers and inoculated with rust. He even found he could successfully inoculate disks of leaf tissue floating on dishes of water.

It is interesting to note that in Kenya these methods were of little use, as the incubation period is much longer and the leaves often decay before spore production starts. Mayne found that, as with the cereal rusts, the fungus existed in a number of different races, which could not be distinguished by appearance, but which differed in the coffee varieties which they could attack. Thus one race could attack the 'Coorg' variety, but not 'Kents', whilst another could attack both. The apparent losses of resistance were due to the appearance of new rust races, which could attack varieties which those present earlier could not. Mayne was able to distinguish four different races of rusts. By inoculating the available coffee varieties with cultures of these races he was able to discover which could resist attack by all the races of rust which had been found in Southern India.

In addition, considerable selection and breeding work has been carried out at the Ballehonnuroc Coffee Research Station in Mysore both with Robusta and Arabica coffee. A selection, S.26, believed to be the result of an inter-specific cross between Robusta and Arabica, is the ancestor of a number of resistant varieties produced at this station.

Investigations in Portugal

Of recent years Wellman, working at the Inter-American Institute of Agricultural Science at Turrialba, Costa Rica, realised that rust was a serious menace to New World coffee. He argued that one day, however strict the quarantine measures, rust would in all probability spread to the Americas. He therefore produced a scheme for investigation and breeding work so that, should this happen, the coffee growers in these regions would be prepared.

His scheme was accepted by the Foreign Administration Organisation of the U.S.A. and in 1952, together with Cowgill, Wellman set off on a fact-finding tour of the Old World coffee-growing countries. In July he visited Portugal's rust specialist, Dr. B. d'Oliveira, who had recently become interested in coffee rust. A centre was required for the testing for resistance to rust of coffee varieties from all over the world. For this purpose a wide range of rust collections would be needed. Such a centre could not be situated in a coffee-growing country for fear of introducing rust races not previously present. Lisbon seemed a very good place for this work and Dr. d'Oliveira enthusiastically agreed.

At first the investigations had to be carried out in the evenings and at weekends so as not to interfere with d'Oliveira's normal work. Eventually, however, funds were provided by the Foreign Operations Administration Organisation (FOA) of the U.S.A., the Portuguese Overseas Ministry, the Coffee Board of Portugal and other sources. A new building was erected outside Lisbon at Oeiras, together with greenhouses and inoculating chambers, and special staff were engaged, and thus the Centro de Investigação des Ferrugens do Caffeiro (Coffee Rust Investigation Centre) came into existence.

Wellman and Cowgill sent back collections of rust and coffee varieties obtained during their world tour. These were soon supplemented by further material sent by the coffee investigators they had met during their investigations and over a thousand different coffee variety samples and several hundred rust collections have since been tested.

Modern techniques

Testing now is by the inoculation of leaves of young living plants grown in pots. A mass of spores is transferred on a sterile knife tip to the lower surface of the leaf to be inoculated. The spores are then distributed over the leaf surface with a dry, sterile paint brush. The under surfaces of the inoculated leaves are sprayed lightly with water and then the whole plant is thoroughly sprayed and placed in a moist concrete chamber, which is kept darkened for three days. Other methods of inoculation are also sometimes employed.

After three to five weeks, if the plant is susceptible to the rust sample used, the leaves become thickly covered by orange, circular, powdery spots

about 3 mm. in diameter. If they are strongly resistant no signs of any reaction may occur, or with less marked resistance yellow flecks or spots may appear, but will develop few, if any, spores.

Each new rust accession is tested on a range of varieties and is classified according to which of these it can attack and which are resistant to it. So far 10 distinct types or 'races' have been distinguished by d'Oliveira and his co-workers[10] and these are designated by Roman numerals. Two of these do not attack Arabica coffee, but only Robusta and other species.

Rust races and coffee varieties

Similarly each new coffee variety accession is tested with each race of rust (and often other rust accessions in addition). They have been found to fall into nine groups according to their reactions to the rust races. These groups are designated by capital letters The inter-reactions are shown in Table 1.[11]

Group I is resistant to all races except X and includes a number of plants from Ethiopia. Group C is resistant to all races except numbers III and X and contains varieties again of Ethiopian extraction, notably 'Geisha' and 'Dilla and Alghe' from the Coffee Research Station, Kenya. Incidentally, not all plants of these varieties show this reaction, 'Geisha' being a particularly variable type.

Group H contains plants of the Indian variety, S353.

Group G is again largely of Indian origin, containing plants of the selections Sel 288, Sel 333, Sel 795 and several B.A. (Ballehonnur Arabicas) selections. A plant from Ethiopia and some first generation hybrids of Brazilian, and African or Asiatic coffees, made at Campinas (Brazil).

Group D shows the type of resistance typical of the 'Kents' variety. Plants of this type are widespread. It contains the varieties DK1/6 from India, K7, SL6 and SL33 from Kenya, and H1, H66 and N39 from Tanganyika. It has been a most useful source of resistance in the past.

Table 1

Reactions of certain coffee varieties to various rust races

Rust races	*Coffee varieties*								
	Coffea arabica							*C. congensis*	*C. racemosa*
	A	I	C	H	G	D	E	B	F
I	*	*	*	*	*	†	†	*	†
II	*	*	*	*	*	*	†	*	†
III	*	*	†	*	*	*	†	*	†
IV	*	*	*	*	*	*	*	†	†
V	*	*	*	*	*	*	†	?†	†
VI	*	*	*	*	*	*	*	*	†
VII	*	*	*	‡	‡	*	†	*	†
VIII	*	*	*	†	†	†	†	*	†
IX				*	†	*	†		
X	*	†	†	*	*	†	†	*	†

Key: * = resistant; † = susceptible; ‡ = moderately susceptible.

No collection of race IX has yet been sent to the Centre and its reactions are given from Mayne's reports. Race V needs confirmation as the original culture has been lost.

It will be seen that Group A contains coffees which are resistant to every culture of rust so far received. It includes two plants of a self-fertile Arabica hybrid from Timor and a large number of plants of non-Arabica species, such as *C. congensis*, *C. canephora*, *C. excelsa*, *C. liberica* and *C. stenophylla*. The discovery of fully resistant pure Arabica plants is most interesting and these should prove extremely valuable.

Group E contains the majority of Arabica coffee varieties. It is noteworthy that all the coffee varieties of the New World, except those recently imported from the Old World, belong to this group, *i.e.* they are fully susceptible to every rust race which can attack Arabica coffee. Thus it is not because the varieties grown in the Americas are resistant to rust that it has not appeared there, as has been suggested.

Groups B, F and J contain non-Arabica species. Group F contains plants which are susceptible to all the known rust races. The species *C. racemosa* is typical of this group, which also contains some plants of *C. canephora*, *C. congensis*, *C. excelsa*, *C. liberica* etc. Group B contains many collections of Robusta coffees. Group J contains plants of *C. excelsa* and of two wild species.

Robusta coffees belong to Groups B, F and A, a considerable number showing full resistance. *C. excelsa* and *C. liberica* also comprise some fully resistant types. It is noteworthy that some races which attack Robusta and other coffee species can also attack Arabica.

Fully resistant varieties of Arabica

At the present stage the results of the investigations would appear most encouraging. Without recourse to breeding, fully resistant pure Arabica lines have been discovered and in the other commercial species such types are quite frequent. It remains to be seen whether, when these types are grown widely in the field, some hitherto unknown rust race may attack them. Once resistant varieties have been found, the next stage is to distribute the material to the regional coffee and agricultural research stations of the world for field testing and eventually for selection or breeding for satisfactory cultural characteristics. A start has already been made and material from the Rust Research Centre is already being grown under field conditions in various parts of the world.

It is likely that, in addition to varieties possessing full resistance, it will be possible to breed resistant varieties from those which now show only partial resistance. Thus from a Group D coffee, resistant to all except race I, and a Group C coffee, resistant to all but race III, it may be possible to breed a coffee resistant to both races I and III, and this would therefore be resistant to all races at present known. Not enough is known about the genetics of resistance to be sure at the present stage that this will be possible.

Even without further breeding, however, some of these partially resistant coffees may be of value. Thus the variety K7, which was selected in Kenya, has been found by the writer to be difficult to infect with race I in cool weather at the Coffee Research Station, at Ruiru, Kenya; even in warm

weather the incubation period is very long. In the field, at high altitudes, it would appear that it remains free of infection, whereas at lower altitudes, although it does become attacked by race I, it does not suffer nearly as much as the Group E coffees do when they are attacked by race II.

Thus, although not fully resistant, it is still a most useful variety in these areas, giving a satisfactory crop when other varieties are heavily defoliated. It should therefore be remembered that greenhouse testing is apt to be rather rigorous and a variety classed as 'susceptible' in such tests may still show a useful degree of resistance in the field.

New races of rust

The question arises as to whether, as new resistant varieties are found, new races of rust will not make their appearance and largely neutralise the advances made, as has occurred with the cereal rusts. This is quite likely to happen, especially as it is not until the correct 'bait' in the form of a variety only susceptible to a certain race or races is grown extensively in the field that the race which can attack it can be 'caught'. Further, only relatively few rust collections have as yet been made and tested.

Even when all the naturally occurring races have been obtained there is still the possibility that new forms may make their appearance. In this respect the coffee breeder may be luckier than the cereal breeder, as it would appear that coffee rust has no sexual stage by which new combinations of genetic material can be produced, and hence new races of rust may be produced less abundantly. The outlook is thus rather more hopeful than it is with cereal rusts. On the other hand, new coffee varieties take a much longer time to produce and to replace the old ones in the field than is the case with cereals.

The work which is being carried out by Dr. d'Oliveira and his colleague, C. J. Rodrigues, at the Coffee Research Centre in Portugal is an excellent example of international co-operation, and it is likely to be of great benefit to all the coffee-producing countries of the world.

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The Rambutan

(*Continued from page* 255)

rapidly as land development schemes were started as a result of replanting of old rubber land and smallholdings as part of extension plans. It was essential, however, to ensure that the budwood used in nursery operations was from material of high quality supplied by the Department of Agriculture. In 1954 Chinese growers in two districts in Perak started fruit nurseries. Nursery technique is somewhat similar to that of rubber, *Hevea brasiliensis*, excepting that budded rambutan seedlings are established in bamboo baskets before delivery.

Bud-grafted rambutan plant ready for planting

These nurseries have sold approximately 38,000 bud-grafted fruit trees during the period 1955-58, and 13 different clones were used in producing these plants, which were purchased mainly for distribution in the State of Perak. As production increases it will become necessary for commercial nurseries to produce their own clonal budwood, the quality of which will determine ultimate results.

A sound start has been made in ensuring the supply of good quality rambutan fruit in Malaya and progress in this and other fruit improvement seems assured.

Infra-Red for Hops

It is learned that unusual equipment for the drying of hops has been installed at a centre in the Zatec district of north - west Bohemia, Czechoslovakia. The drier, manufactured by the Agrostroj works, employs infra-red rays to provide a heat of up to 100°C. It is stated that hops from 3½ acres can be dried in one day and the drier may also be used for hay, corn and potatoes.

Robot Planter

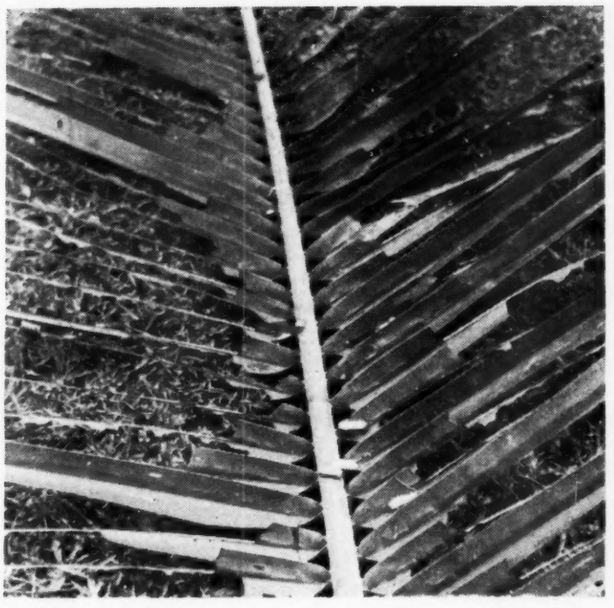
While the present-day tree planter is a relatively inexpensive tool in itself, it needs a tractor to tow it and the labour of two men to operate it, and this makes it an expensive proposition. What obviously is needed is a self-propelled unit, which can be operated by one man, who would drive the machine and feed seedlings into the planting mechanism, according to W. C. Finley, of the Batelle Institute, Ohio, U.S.A.

Furthermore, there is no reason why the ground should be ploughed before planting, for all that is needed is a suitable planting hole for each seedling. For this purpose either a chain mechanism or a rotating drill operated from the p.t.-o. could be used to make holes about 6 in. dia. and 18 in. deep.

To round off these suggestions, he says, why not apply water and fertiliser from the planting machine and add a chisel cultivator to remove any weeds or grasses between the rows.

Mouldy Rot

It was stated in our February issue that 'Fylomac 90' was recommended by the Rubber Research Institute of Malaya as the best material for the control of mouldy rot of rubber. Actually, 14 preparations (including 'Fylomac 90') have been officially approved for the purpose.



Left: *A coconut palm almost defoliated by caterpillars of* Parasa lepida. Right: *Larvae feeding on the leaves (the white caterpillars can be seen)*

Insect Pests of Coconut Palm in India—2

K. K. NIRULA and K. P. V. MENON*

Continuing this review, the authors first describe the coconut cockchafer, which is a very serious pest in India.

THE cockchafer, *Leucopholis coneophora* Burm., is a serious pest of coconuts in some parts of Kerala. The larvae feed on roots of the coconut palm, causing the leaves to turn pale yellow. The infestation results in a great reduction in nut production. Besides coconut palm, the pest attacks inter-cultivated crops, such as tapioca, sweet potato, *Colocasia*, yam, plantain etc.

Birds are the most important predators of larvae of this pest and are extremely active when the soil in the infested area is ploughed up. The striped squirrel, rats, cats and dogs are also found preying upon the pest.

Tillage and deep ploughing of the soil at the time when the pest is abundant have been suggested as measures of control. The application of 5% chlordane at the rate of 28 lb. per acre was also found to give good results.

Contheyla rotunda H. This leaf-eating slug caterpillar is a pest of sporadic occurrence, but at times it is capable of causing considerable damage. During severe outbreaks its larvae completely defoliate the palms, causing heavy yield reduction, and sometimes spathes and nuts are also attacked. The pest is common only on the west coast of India.

The larvae of this pest is parasitised by *Rogas* sp., and the pupae by *Antrocephalus* sp. and *Chrysis* sp. Successful control was obtained by spraying the foliage with 0.1% DDT.

Macroplectra nararia Moore. On the east coast of India the spiny slug, *Macroplectra nararia* occasionally attacks coconut palms and may cause extensive damage. It has recently assumed major proportions in the east and west Godavari districts of Andhra Pradesh.

According to Dharamraju, the pest is attacked by a Braconid in its larval stage, by a Chrysidid and two different species of Chalcids in its pupal stage. The pest was brought under control by spraying coconut leaves with 0.2% DDT.

Sporadic outbreaks

Parasa lepida Cram. This is another Limacodid which infests young coconut palms. It is present in coconut plantations all the year round on the west coast, but severe infestations occur only sporadically. The larvae feed on leaves, leaving behind only midribs.

The larvae are heavily parasitised by *Clinocentrus* sp., *Stomatoceros ayyari* and *Eurytoma parasae*.

The pest can be controlled by

* Central Coconut Research Station, Kayangulam, South India.

mechanical destruction of larvae and pupae. Recently, dusting with 5% BHC has given satisfactory control.

Seedlings and butterflies

Gangara thyrsis Moore. This is a Hesperid butterfly, the caterpillars of which attack young coconut seedlings one to two years old. It is very common throughout the west coast of India and at times causes considerable damage.

The pest is subject to attacks by a number of parasites and predators, which keep its population under control. Hand picking of the caterpillars and pupae and spraying with 0.2% DDT are suggested as control measures.

Suastus gremius Fb. This is another Hesperid butterfly, the larvae of which feed on various palms like coconut, palmyra, date etc. It is generally a minor pest, but may cause considerable damage.

For control, hand collection of larvae and pupae in case of minor attack, and spraying with 0.2% DDT in case of widespread infestation, are suggested.

Cyclodes omma V. de H. The caterpillars of this Noctuid moth bore into tender nuts and feed on the contents, causing the nuts to drop. The insect is not very common on the west coast of India, but whenever it occurs it causes considerable damage and is potentially a very serious pest.

Betrachedra arenosella Walk. This is a Tineid moth, commonly known as the lesser spike moth. The larvae are generally found gnawing the male and female flowers of coconut palm and the injured female flowers frequently turn distinctly black.

Diocalandra stigmaticollis Gyll. This small, dark, tan-coloured weevil, in both adult and the larval stages, tunnels leaf petioles and flower stalks of coconut palms. Recently the weevil was found in very large numbers in Kerala on coconut palms affected by stem-bleeding disease.

Coconut leaf scale

Aspidiotus destructor. This widely distributed Coccid, known as coconut scale, feeds on a wide range of plants and is especially destructive to coconut and plantain. It feeds mainly on coconut leaves and in heavy infestations the leaves may become encrusted with the scales, turn yellow and die. The pest has spread throughout the coconut-growing areas of India and is more common during dry weather.

It is attacked by a number of parasites and predators; of these, the predatory Coccinellid beetles are very important. Lime sulphur spray has been used for a long time for the control of this pest, but recently spraying with 0.025% parathion has given good results.

Stephanitis typicus. This is a small Tingid bug, which is often found on tender leaves of coconut palm. By sucking the sap of leaves the insect causes rather negligible damage to the host. Recently Nagaraj and Menon suggested that it may be responsible for the spread of disease or wilt of coconut palm, which is probably of virus origin.

Oecophylla smaragdina F. This red ant occurs throughout the plains of the Indo-Australian region. It builds its nests in the folds of coconut leaves, usually on trees infested by Coccids, as the ant lives to a large extent upon the honey-like exudation of the scales.

Recently *Oecophylla* was observed in parts of Kottayam district (Kerala), causing heavy damage to palms by colonising *Pseudococcus* sp. on inflorescences. The infestation of the scales results in nutfall and considerable yield reduction.

The radical control of this ant consists in the destruction of the nests by burning them with torches during the night. Recently, spraying with chlordane, aldrin and parathion has been reported to give good results.

. . . and finally termites

The termite, *Odontotermes obesus*, is a serious pest of coconut seedlings in laterite areas. The seedlings may be attacked either through the base of the seednut or at the collar portion. The wilting of the central shoot is usually the first visible symptom, which is often followed by the death of the seedling.

Soil application of 10% BHC dust in coconut nurseries before the sowing of seednuts, at a rate of 100 lb. per acre, keeps the seedlings free from termite attack. Among new insecticides tested recently, parathion, pentachlorophenol, sodium pentachlorophenate and chlordane were found to be very effective.

Photos: F. C. Cooke

Palm leaf attacked by Aspidiotus destructor

Photo: Kenya Information Department

Sisal being sun-dried on a Ruiru estate, Kenya

Herbicides in Sisal Cultivation

2—The Economic Benefit to the Grower

S. D. FLEMING*, B.SC.

In a previous article the progress made in evaluating herbicide treatments for use in sisal during the last 10 years has been reviewed. The present article sets out the ways in which sisal growers can benefit by integrating these newly developed practices into their overall cultivation programme.

THE pattern of herbicide development has followed the priority of the problems in the industry. Perennial grasses were the most acute problem in sisal when work was started in 1952 and consequently the early programmes aimed at devising methods for their control.

The first problem

Perennial grasses present the most serious problem in land about to be planted to sisal bulbils; of secondary importance is their control in established sisal, where grasses reduce yields and make cutting difficult.

As a result of the trial work which has been done, satisfactory methods of control based on the use of dalapon (sodium 2,2-dichloropropionate) have been worked out and have recently come into commercial use.

The extension of commercial control programmes has involved modification of cultivation techniques and the development by individual estates of practices to suit their particular needs.

The second problem

Once satisfactory control measures for perennial grasses had been devised attention was focused on the control of broad-leaved weeds.

Since sisal bulbils are the stage of the crop which is most susceptible to broad-leaved weed competition, trial work on broad-leaved weed control was directed mainly to the development of suitable herbicides for bulbil nurseries, and satisfactory control measures were developed involving the use of MCPA.

Next—preventive weed control

Having established successful 'curative' treatments, attention was turned towards devising methods of preventive weed control to maintain a high standard of cultivation over long periods by chemical means.

This has been made possible during the past two years by the introduction of a new group of herbicides, the triazines. Experimental results show that a single application of simazine or atrazine at a dosage of 4 lb./acre of the 50% wettable powder (in 50 gal. or more of water per acre) can give up to five months' control of annual grasses and broad-leaved weeds.

The prolonged effectiveness of the triazines is due to their insolubility in water, which allows them to remain in the top layer of the soil to kill emerging weed seedlings. A well-prepared and clean soil surface is required for best results, so encouraging a high standard of land preparation prior to planting of the crop.

The optimum cultural conditions are therefore fulfilled where preventive weed control with simazine or atrazine is carried out; the soil is clean at the start, persistent weed control reduces the need for extensive and regular hand weeding and only a limited amount of

*Fisons Pest Control (E.A.) Ltd., Nairobi, Kenya.

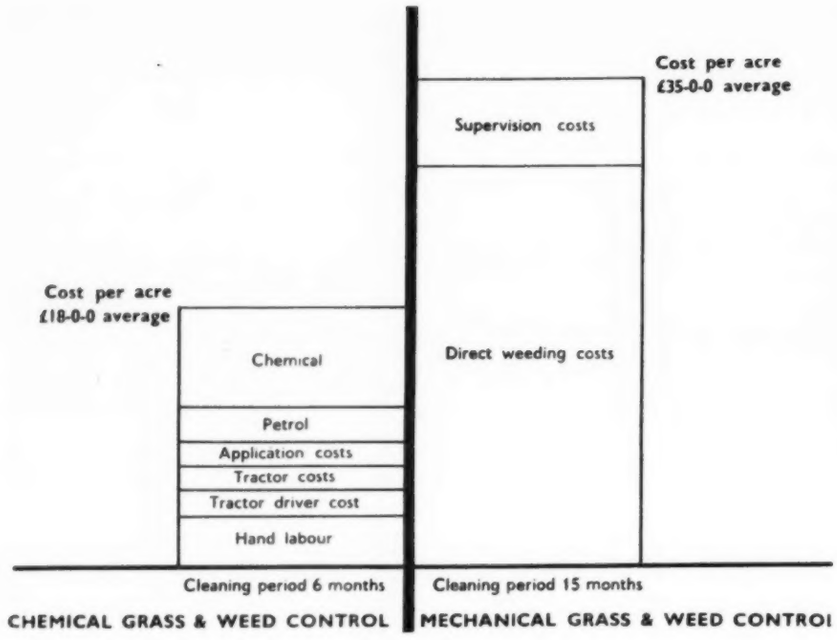


Fig. 1 Pre-treatment of land for Couch Grass control

hand cultivation is necessary to maintain soil texture and deal with any isolated deep-rooted weeds which may survive.

In the nursery, combined treatment of simazine or atrazine with MCPA at the time of planting, followed by periodic MCPA treatments during the life of the nursery, can ensure maximum growth and a full even stand of bulbils at the time of lifting. This is of particular importance because of the 12-18 months' life of a bulbil nursery and the fact that nursery plants are preferred to suckers for replanting old sisal areas, because of their uniform, strong and more even growth.

Combined chemical and manual programmes

Based on the extensive field-scale trials which have been carried out in recent years, it is possible to set out a programme for combined chemical and manual clearance of land intended for planting. Chemical treatment with sodium 2,2-dichloropropionate, combined with a small amount of hand weeding and possibly some spot treatments with MCPA for broad-leaved weeds, enables the clearing operation to be carried out in a much shorter period of time than by the traditional methods of purely mechanical clearing.

A cost comparison has been made based on average estate costs for a programme of this kind. This is set out diagrammatically in Fig. 1.

There is, of course, considerable variation from estate to estate of the cost of individual operations, ranging from an overall cost of £20-50 per acre. The higher figure applies in areas where there are heavy infestations of couch grass and where additional mechanical and hand cultivations are required prior to planting.

From this it can be seen that the use of herbicides has several distinct advantages over traditional methods. These advantages are:

(*a*) *Couch-type grasses* are controlled *to a very high degree* (over 95%), to the extent that they need never be a problem in the treated area again. Naturally, maintenance treatments on a 'spot application' basis will be required where grasses persist, but this can be done at very low cost per acre, both in labour and materials.

(*b*) *Time is saved.* The whole sequence from pre-ploughing of the land to the date of planting can be condensed into a period of only six months.

(*c*) *Humus is conserved.* The soil structure is maintained and moisture retention properties are improved.

Traditional methods are far more time-consuming, for land preparation has to be started early in the year prior to planting, and full control of couch grasses is seldom achieved at an economic figure. The control achieved is at best a compromise with the problem, as a result of which money continues to be spent on the land after planting.

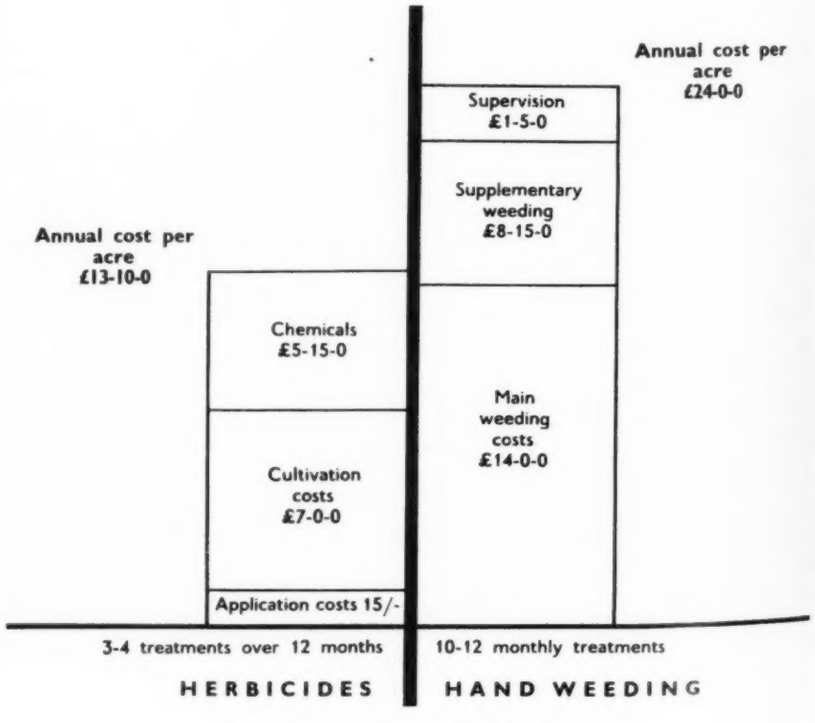
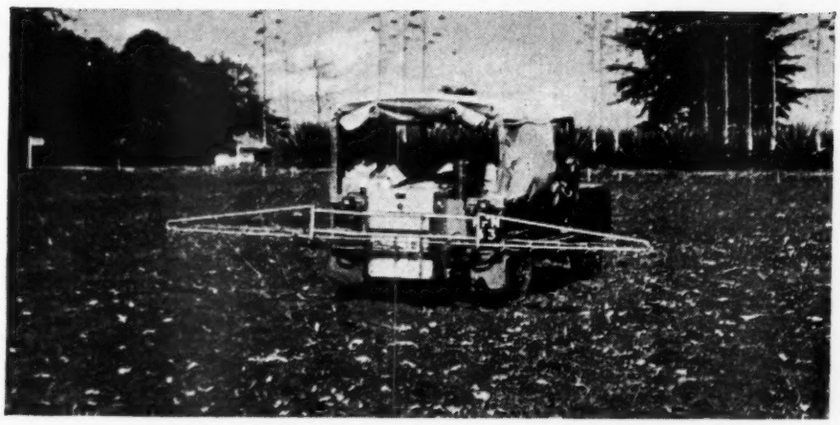


Fig. 2 Weed control in sisal bulbil nurseries

Continual mechanical and hand cultivation of the soil, under tropical conditions in particular, reduces the humus content, tends to destroy the structure of the soil, and hence impairs its moisture-retention properties. In extreme cases the soil structure is so altered as to result in wide-scale erosion under high rainfall or dry weather/high wind conditions.

Growth of the sisal under such conditions is uneven and slower than usual. Yields suffer in consequence, with the result that the growth cycle is extended by cutting at a reduced rate.



Logarithmic sprayer at work in the sisal bulbil nursery of the Sisal Research Station, Kenya

Programmes for bulbil nurseries

Extensive field trials carried out since 1958 have enabled combined weed control programmes for maintenance of bulbil nurseries to be established. As previously indicated, application of one of the triazine herbicides to clean well-prepared land at the time of planting will give a long period of weed control. Subsequent spot treatments with MCPA to control localised areas of weeds can be carried out very cheaply and a small amount of hand cultivation assists soil conditioning.

A cost analysis has been carried out based on average estate costs for such a programme and comparison with hand weeding costs is shown graphically in Fig. 2.

The advantages of this programme, apart from the overall reduction in cost, have been discussed in detail in Part 1. They are briefly:

(*a*) No loss of plant population due to careless hand weeding.

(*b*) Full growth of the bulbils, which suffer little or no check to growth due to aggressive weed and grass competition, or mechanical damage by the weeding gangs.

(*c*) No undue disturbance of the soil results from this system.

Only those cultivations needed for aeration and moisture conservation in the soil need be carried out.

Future problems

As the general problems of weed and grass control are overcome with herbicides more specific problems arise which merit particular attention.

Photos: Fisons Pest Control Ltd.

Left: *Grass-infested bulbil nursery one month after planting. The central plot was treated with simazine + MCPA.* Right: *Sisal bulbil nursery two and a half months after planting, kept clear of weeds and grasses by a post-planting application of simazine at 4 lb. per acre initially applied to the clean soil*

Scientists have come increasingly to realise that no one chemical can be the perfect selective weedkiller, *i.e.* can discriminate completely between weed and crop plant.

Instead, individual chemicals must be regarded as suitable tools; each component herbicide of an overall programme being calculated to give satisfactory control of a specific weed group or species, or to protect a particular phase in the crop development.

In this way lower dosage rates of individual herbicides became practicable, with increasing crop safety and lowering of cost; the overall spectrum of weeds which can be controlled by herbicides has also been greatly increased by such methods. Thus it is possible to approach an almost complete chemical weed control programme where manual methods are used mainly as a supplement to assist in conditioning the soil.

Coming Events

I.C.T.A.—The U.K. branch of the I.C.T.A. Association is holding an open meeting in the Assembly Room, Colonial Development Corporation, 35 Hill Street, London, at 3 p.m. on 22 July. Mr. N. W. Simmonds will give a paper entitled 'Adaptation, Adaptability and Breeding System'. Admission free, without ticket, to all interested in tropical agriculture.

Grasslands.—The summer meeting of the British Grassland Society will be held in Harrogate, Yorkshire, from 25-29 July, with the Yorkshire County Grassland Society acting as host. Details of the programme and application forms may be obtained from Mr. G. Williams, B.G.S. Local Secretary, 'Bryn Hyfryd', 9 Chesham Road, Wilmslow, Cheshire.

Plant Protection.—An international meeting on Organisation and Methods of Plant Protection is to be held at Wageningen from 1-26 August, 1960. Further particulars may be obtained from the Director, International Agricultural Centre, 1, Generaal Foulkesweg, Wageningen, Netherlands.

Agricultural Co-operation. — The British Council, in association with the Plunkett Foundation and the Federation of Agricultural Co-operatives of Great Britain and Ireland, is organising a course in agricultural co-operation at Cropthorne, Worcestershire, from 14-27 August. Applications should be made to the Director, British Council, 65 Davies Street, London, W.1.

Science.—The British Association for the Advancement of Science will hold its annual meeting in Cardiff, Glamorganshire, from 31 August-7 September. Of particular interest is the Symposium on World Food and Population, which will be held on Monday, 5 September. The principal speakers will include Dr. N. C. Wright, Deputy Director-General of FAO; Prof. D. V. Glass, Professor of Sociology in the University of London; Prof. W. A. Lewis, Principal, University College of the West Indies; Dr. L. Dudley Stamp, Director, Land Utilisation Survey of Great Britain; Sir Alexander Fleck, Past President of the Association; Dr. H. D. Kay, Professor Emeritus, University of Reading; Prof. P. M. S. Blackett, Professor of Physics, Imperial College of Science and Technology. Copies of the preliminary programme may be obtained free of charge from the Secretary, British Association, 18 Adam Street, Adelphi, London, W.C.2.

Rubber Research.—An International Conference on Natural Rubber Research, sponsored by the Rubber Research Institute of Malaya, with the support of the Government of the Federation of Malaya and the Rubber Producers' Council, will take place in Kuala Lumpur from 26 September–1 October, 1960. Further information may be obtained from the Rubber Research Institute of Malaya, P.O. Box 150, Kuala Lumpur.

Weed Control.—The 5th British Weed Control Conference will be held in Brighton from 7-10 November. Subjects to be discussed during the main session are: The Impact of Herbicides on Crop Husbandry; Weed Control in Arable Crops; Improvement of Pastures and Hill Grazing—Bracken Control; Problems of Advice and Education; Control of Grass Weeds; Weed Control in Horticultural Crops; New Herbicides; Weeds of Waterways; New Techniques in Agriculture and Horticulture; Translocation and Fate of Herbicides in Plants. Information and registration forms from the Secretary, 52 Bedford Row, London, W.C.1.

Corrosion.—The 1960 Exhibition will take place at Olympia, London, from Tuesday, 29 November, to Friday, 2 December.

Full information is available from the Organiser, *Corrosion Technology*, Leonard Hill House, Eden Street, London, N.W.1. (*See also page* 272)

Agricultural Exhibitions

Germany.—An Agricultural Exhibition is to be held at Saarbrucken from 23 April–21 October. Further information from Ausstellungstechnische Leitung und Organisation Stadtverwaltung, Saarbrucken.

The National Agricultural Show takes place in Stuttgart from 24 September—2 October. Information from Stuttgarter Ausstellungs G.m.b.H., Am Kochenhof 16, Stuttgart-N.

Australia.—An Agricultural and Industrial Exhibition will be held in Brisbane from 11-20 August. It is organised by the Royal National Agricultural and Industrial Association. Details may be obtained from G.P.O. Box 122B, Brisbane, Queensland.

The Royal Agricultural Show is to be held in Perth from 30 September-6 October. Particulars from the Royal Agricultural Society, 239 Adelaide Terrace, Perth.

U.S.A.—The 8th annual Farm Progress Show will be held near Joliet in Will County, Illinois, from 21-23 September. There will be displays of farm machinery, feeding stuffs, seed, fertilisers, chemicals, petroleum and other crop production equipment and materials. Demonstration plots have been prepared to show the effectiveness of fertilisers and some pest control chemicals. Seed firms will display 200 varieties of hybrid maize, besides sorghum and soya beans. Various types of farm machinery will be seen in action on the demonstration plots. Further information from the Organiser, Farm Progress Show, Prairie Farmer Publishing Co., 1230 Washington Boulevard, Chicago, Illinois.

After-Care in Soil Conservation Work

W. B. PERKINS, H.D.A.*

Whilst earthworks are necessary to bring erosion under control, the establishment and maintenance of a good vegetative cover is essential.

Well-grassed diversion bank carrying an excellent stand of Rhodes grass

THE use of vegetation in the protection of soil from erosion has long been realised and should now be widely appreciated by the landholder. To many people, however, soil conservation still only involves the construction of mechanical earthworks. It is very mistaken to assume that once mechanical earthworks are carried out previously eroded areas will quickly grass over and return to production without assistance.

Whilst earthworks, such as diversion banks and pasture furrows, are generally necessary to bring erosion under control and reclaim badly eroded areas, some form of vegetative treatment is also necessary to complete the reclamation and return the land to maximum safe production.

It must be realised that vegetation is the greatest agent in erosion control and earthworks are only supplementary. Wise management is essential on pasture lands so that they have a permanent cover which provides protection and allows maximum penetration of rainfall. Similarly, crop lands must be managed intelligently to avoid depletion of soil fertility and ensure continued productivity without undue risk of erosion.

Immediately earthworks are constructed, the first step taken by the landholder should be the sowing of recommended improved pasture species on all disturbed soil. This will help to ensure a quick cover following the first rains. The use of fertiliser to hasten growth is strongly recommended, especially in the treatment of badly eroded country.

Bank outlet stabilised by the use of kikuyu sods

Rabbit control

In any erosion control programme one of the first considerations is the suppression and control of rabbits. It is of major importance that boundary fences be properly netted and rabbit eradication carried out by approved and recognised methods. This cannot be too strongly emphasised, as rabbits will quickly burrow into the earth freshly disturbed by earthmoving plant. Once they become established in soil conservation works, such as banks, gully control structures etc., it becomes a difficult and arduous task to remove them. Then, during heavy rain, water will escape through the burrows, causing collapse of the structures and thus necessitating costly repair.

Outlet protection

In all mechanically-constructed soil conservation works, such as graded banks, diversion banks, silt traps etc., the critical point is the outlet. It is here that water generally flows at the maximum velocity and if damage is going to occur it will generally occur here first.

These outlets should always be sodded or sprig planted with a good turf-forming grass and possibly the

* Soil Conservationist, Muswellbrook.

Left: *Gully originating at roadside culvert completely stabilised by the use of kikuyu grass.* Right: *Severe sheet erosion caused mainly by overstocking and rabbits*

most suitable species for this use would be kikuyu, *Pennisetum clandestinum*. This hardy grass, if wisely managed, will spread quickly and form a dense permanent cover which will protect the soil and allow maximum amount of water flow, without damage.

The benefit obtained from sodding these small areas is reflected over a far greater area, and this type of treatment is an insurance against damage to mechanical structures or land.

Pasture furrows

If pasture furrows are constructed, they should be sown to improved species, top-dressed regularly and carefully watched, especially during the early stages following heavy rain. Any low spots along the furrows should be noted and repaired as soon as possible. These will occur owing to the furrows being intersected by stock pads and small rills, or to the tractor having deviated slightly from the contour line during construction. This may be remedied with a shovel by building earth stops in the furrow channel on either side of the low spot. It is advisable to carry out this repair work immediately following rain, when the ground is in a wet condition and thus easier to work.

Gully control

In gully control work, it is often practicable after treatment of the catchment to fill the gully or batter down the sides, but special after-care is essential to ensure stabilisation of the area and protection against further scouring.

The area should be heavily seeded, top-dressed and sodded if practicable, or, alternatively, sprig planted with a good turf-forming species, such as kikuyu. Straw mulching of the area is strongly recommended, as it will protect the soil, increase absorption, reduce evaporation and thus ensure a much quicker recovery. Mulch may consist of old hay, straw or natural grass hay from grazing lands. The latter would generally be preferable, due to the extra seed contained in the mulching material. Temporary fencing to exclude stock until the area is stabilised is highly desirable and would ensure a quicker and more certain recovery.

Prompt repair

It is not practicable to design earthworks to withstand the very heaviest rains. Occasionally heavy rains will exceed the capacity of earthworks, causing overtopping and damage to existing structures. In the event of this happening immediate attention will be necessary to repair the breach before subsequent rains cause further damage.

In conclusion, it is necessary to stress the importance of good management, for if the soil is over-cropped and over-grazed no soil conservation measures will prevent erosion from continuing.

(Abridged version of an article in the *Journal of the Soil Conservation Service of N.S.W.*, 1958, **14**, No. 4.)

The Corrosion and Metal Finishing Exhibition

Olympia, London. 29 November to 2 December

The organisers of the Corrosion Exhibition have decided to change its name in view of the fact that many exhibitors will be showing products which both protect and finish metals.

The Exhibition is bound to be of immense interest to those who serve the agricultural industries of the world —the agricultural engineers, the chemical engineers and the chemists. Agriculturists, farmers and foresters who know the problems presented by the soil, by moisture and in the use of fertilisers, can appreciate the need for protecting their machinery, farm buildings and equipment against these agents of corrosion, which not only impair the efficiency, but also shorten the life of valuable equipment.

The scope of the Exhibition is immense, for it covers paints, plastics, rubbers and resistant metals; galvanising, anodising, electro-plating, metal cleaning, colouring and polishing; paint application, phosphating plastics coating and metal spraying; cathodic protection, water treatment, inhibitors and protective systems; derusting and descaling; corrosion-resistant plant, linings and pipelines; acid-resisting floors and tanks; specialised packaging; and testing apparatus for corrosion and metal finishing.

A significant feature is the growing official support with the Exhibition still six months away. The Department of Scientific and Industrial Research and the Atomic Energy Authority are exhibiting; the Corrosion Group of the Society of Chemical Industry are to hold a meeting during the Exhibition.

New Publications

Tropical Silviculture

Prepared by I. T. Haig, M. A. Huberman and U. Aung Diss. FAO Forestry and Forest Products Studies, No. 13, 1958. In 3 vols. Vol. I, 10*s*.; Vol. II, 20*s*.; Vol. III, 5*s*.

At the fourth World Forestry Conference held in 1954 at Dehra Dun, Northern India, a series of papers was presented for the section on tropical silviculture which probably constituted the most comprehensive collection of information on tropical forest conditions and silvicultural practices that had ever been brought together at one time. A selection of these papers, 44 in number, have been reproduced as volumes II and III of this FAO study, and the opportunity has been taken by the three co-authors of compiling a critical summary and evaluation of the present status of knowledge of tropical silviculture the world over. This study constitutes volume I.

The study has been made with particular reference to the regeneration of natural forests. Silvicultural methods involving plantations and planting are specifically excluded and no attempt is made to describe silvicultural practices in detail, though considerable information on them is to be found in the various papers in volumes II and III.

It is impossible in a short review to do justice to the wealth of interesting information contained in this work. Silviculture in tropical forests, which, incidentally, constitute nearly half of the world's forest area, is far less advanced than in most temperate forest types. This is largely due to the richness in specific composition that characterises tropical forests, and the problems of utilisation and of regeneration are consequently very complex. Nevertheless, as this study shows, there are similarities in the forests constituting the major climatic types, wet evergreen or 'rain forest', moist deciduous and dry deciduous, even though the actual species in one part of the world are quite different from those in another.

Each of these major types has been dealt with under the following headings: occurrence; physical factors of the localities where found; the silvicultural factors, including composition, succession and ecological status; seed production and dissemination seedling establishment and stand development. This is followed by a review of current silvicultural practices.

The information is given for three main areas, namely, the Far East, Africa and America, and it is notable how very much more advanced is the state of knowledge of tropical silviculture in the Far East. Much useful information is now coming from Africa, especially from the Belgian Congo. On the other hand, it is noticeable how little is known as yet about the vast areas of tropical forests in South America, which constitute the world's largest reserves of relatively untouched forest.

In addition to dealing with the three main forest types mentioned above, there are special sections dealing with the more gregarious species, teak (*Tectona grandis*), sal (*Shorea robusta*), mangrove forests and bamboos. The dry deciduous forests, so often neglected, are given adequate treatment, though it is apparent how little is yet known about the silviculture and management of some of them, especially the 'miombo' (Brachystegia-Isoberlinia complex) that covers three million square miles in Central Africa alone.

To each section dealing with a forest type there is a useful summary, and at the end of the book there is a general discussion of the problems and a suggested programme. Throughout this work the lack of basic knowledge and the need for more research and investigations are stressed, and in the final chapter a long list of subjects requiring investigation in any future programme is given. This is most valuable, particularly as the tropical forester is often working in isolation under difficult conditions and is frequently unable to see his problems as a whole, or to know how others have attempted to solve them and with what results.

One serious criticism of this otherwise excellent study is that its stated restriction to studies of natural regeneration very greatly reduces its value. While some tropical forests produce adequate natural regeneration of the more valuable species that the forester wants, many do not, and the forester has to resort to artificial methods—sometimes strip or group planting—but usually with a tendency towards wholesale planting, either after clear-felling or under shelterwood. A number of instances of this are mentioned in the papers in volumes II and III. Artificial regeneration now plays such a large part in tropical silviculture that its omission leaves a large gap, and to that extent the usefulness of this study is reduced.

These publications are excellently produced. There are clear maps in colour of the distribution of the main tropical types and good photographic illustrations at the end of each section. There are also well-selected lists of references to published literature for each chapter. The authors are to be congratulated on a very valuable compilation which gives a concise summary of the status of tropical silviculture as concerned with natural regeneration in the main forest types in different parts of the world, with indications of the directions in which further research and development are needed.

M. V. LAURIE

Forestry Economics

Fundamentals of Forestry Economics by Prof. W. A. Duerr, of Syracuse University, New York. Pp. 579. McGraw-Hill Book Co. Inc., London, 1960. Price 74*s*.

What are the advantages, if any, in having 'dual-purpose' textbooks? Prof. Duerr, who writes on economic and forestry problems, appears to cater mainly for the forestry student who requires to have some understanding of economic concepts relevant to the analysis of forestry problems.

The first part is introductory and is concerned with the range and scope of forestry economics. The second deals with factors of production, supply of processed products and methods of economic planning. The third deals with demand, prices, functions of marketing, marketing agencies and evaluation. Part four concerns itself

with institutions, including business, government and trade unions and with questions of land tenure, taxation, credit and insurance, while part five covers some of the wider aspects of operation and planning of the forest economy, including the world economy.

Some useful innovations are made in the volume. For example, when economic terms are used for the first time, they appear in bold type in the text and the index shows the appropriate page reference in the same way, so that it can act as a glossary. Questions which are directly relevant to the discussions in the text are placed in brackets. Each chapter has a list of main contents at the beginning and a brief summary at the end. There are also numerous graphs and statistics —mainly relating to American forests.

Although the chattiness of some of the writing appears to lead to over-generalisation at some points, the volume, like some of Prof. Duerr's earlier work on the economics of forestry, will be valued for the useful classification, analyses and definition of the many economic problems of the forest industry. It is essentially a volume for students.

J. J. MACGREGOR

Potassium in Japan

Review of Potassium Research in Japan. Pp. 137. Illus. International Potash Institute, Berne, Switzerland, 1958. Price not stated.

The use of potash in Japanese agriculture has increased considerably during recent years, largely as the result of research work at many centres of learning in that country. Apparently, research workers in Japan felt the need for closer liaison in order to appreciate the problems and achieve some co-ordination of effort towards their solution. This resulted in the first Japanese Potassium Congress in November 1957 under the aegis of the International Potash Institute. The present book contains nine papers presented at the Congress. They include discourses on potassium in relation to Japanese volcanic soils, studies on leaf analysis of fruit trees, potassium nutrition of tobacco plants, use of potassic fertiliser on grassland and five articles concerning potassium in relation to rice cultivation.

The five papers on rice cultivation relate to potash deficiency in rice soils, potash on upland fields of high acidity, potash and oxygen respiration, the effect of potash on growth of the rice plant and the relationship between potash and rice diseases.

It is to be noted that the papers cover a wide range of research, but no discussions are published and there is no evidence that the Congress succeeded in drawing together the varied interests of those engaged in potash research. However, the papers are valuable contributions and the author index appended to the volume provides some guide to a bibliography of articles on this subject.

D. H. GRIST

Citrus Nutrition

Leaf and Soil Analysis in Citrus Orchards by H. D. Chapman. Pp. 54. Manual 25, Agricultural Publications, 207 University Hall, 2200 University Avenue, Berkeley 4, California, U.S.A., 1960. Price 75 cents.

This University of California publication is designed to help citrus growers to find out the nutrient status of their trees. It brings together for the first time existing information on how to diagnose and correct citrus nutritional ailments.

The author recommends leaf analysis combined with soil analysis and visual observation for fertiliser guidance. Using this system, growers or others properly instructed in sampling techniques would collect leaves and soil samples, send them to a commercial laboratory for analysis and receive information giving a clearer picture of the trees' nutrient status and needs than has hitherto been possible.

Cobalt in Agriculture

A completely revised edition of 'The Application of Cobalt in Agriculture' has just been released by the *Mond Nickel Co. Ltd.*

The publication draws attention to the fact that since many of the cobalt-deficient areas in the world are currently unknown it is important that the symptoms of diseases arising from this deficiency should be recognised in the early stages. Further, it states that cobalt deficiencies are being aggravated because pastures which once supported a smaller animal population are today maintaining two or three times as many head of livestock.

Deficiency of cobalt is an underlying cause of 'pine', a disease primarily found in sheep, and it is also responsible for acetonaemia and malignant catarrh in cattle.

The publication describes various methods of overcoming cobalt deficiency, including modern techniques, such as administering heavy pills or 'bullets' to the diseased animals. Copies can be obtained free through our Reader Service.

F. C. COOKE

Bulletins and Reports

Alabama Polytechnic Institute, Agricultural Experiment Station. Bulletin 316, September 1959, 'Agricultural Drought in Alabama', a joint contribution of the Experiment Station and the Soil and Water Conservation Research Division, U.S. Department of Agriculture. Pp. 54.

Bulletin 317, October 1959, 'Southern Table Peas' by C. L. Isbell. Pp. 40, illus. in colour.

Bulletin 318, October 1959, 'Nutritive Qualities of Sericea Forage' by G. E. Hawkins. Pp. 18, illus.

Bulletin 319, November 1959, 'Problem Recognition in Agriculture - Managerial Adjustment Opportunities' by J. E. Lee, jnr., and E. D. Chastain. Pp. 35.

Obtainable from the Alabama Polytechnic Institute, Auburn, Alabama. Prices not stated.

Ontario Department of Agriculture. Bulletin 480, revised November 1959, 'Tree Fruits and Grapes in the Home Garden' by G. W. Eaton and O. A. Bradt. Pp. 12, illus.

Bulletin 531, July 1959, 'Peas for Processing' by A. N. L. Butler. Pp. 20, illus.

Both obtainable from the Department of Agriculture, Parliament Buildings, Toronto, Ontario, Canada.

Technical Books
308 Euston Road
London, N.W.1
(Tel: EUSton 5911)
as retail booksellers will be pleased to supply any books reviewed in this periodical, and will give immediate attention to any requirements you may have for other works

Forest Machinery

Like other industries, forestry needs the right tools and machines to do the job efficiently and the need for mechanisation is steadily increasing. To meet this growing need the Forestry Commission of the U.K. recently arranged an exhibition and demonstration of forest machinery at Harrogate in association with the Yorkshire Agricultural Show.

The exhibition, like its forerunner in 1958 (see WORLD CROPS, 1958, **11**, 373), was one of the most comprehensive ever seen in Europe. The machines shown ranged from enormously powerful tractors designed for large-scale land clearance operations to light scrub cutters and hand implements; all of them have their applications in colonisation projects and land clearance operations and in farming and plantation operations in countries overseas. Particularly interested from this point of view were the members of the FAO European Forestry Commission's Working Party on Forest Machinery, who visited the exhibition.

The Leeford ditch-cleaning and digging machine in operation

Forest Fencing

For countries overseas where fencing may be required to run for considerable distances the *Trojan Co.* offered a posthole digger, an economical tool for preparing holes for fence posts. The implement is screwed down into the ground like an auger and the rotating teeth retain the centre core, which can be lifted and deposited nearby. The standard equipment is designed for making holes up to 2 ft. 6 in. deep, with diameters ranging from 2 in. to 1 ft.

The Becfab Mk. I ditcher-dyker at work behind a Massey-Ferguson tractor

Trenchers and Ditchers

Drainage to carry off accumulations of water is an essential forestry operation and *Becfabs (Engineering) Ltd.* were showing their new Mk. IV ditch digger and dozer, which has a 4-ft. blade with hardened steel cutting edge, for cutting ditches in hard, dry soil and virgin land, and which can be fitted to any category one and two tractor with hydraulic linkage. Another useful machine on view was their grip trench cutter, which is attached to the three-point linkage and incorporates a vertical cutting worm driven from the p.t.-o. A third machine, we noticed, was the Becfab ditcher-dyker for cleaning and maintaining waterways and dykes in marshland.

The tractor-mounted ditch cleaning and digging machine shown by *F. A. Hughes & Co. Ltd.* on behalf of *Leeford (London) Ltd.*, the manufacturers, incorporates a telescopic boom fitted with automatic trip gear and controlled by three hydraulic rams. There were several kinds of excavating buckets from 14 in. up to 41 in. wide, for working at depths down to 6 ft., and for producing ditches up to 6 ft. wide.

The main features of the Shawnee

The 'Merry Tiller Major' being used for cultivating and mulching

speed range of 1½ and 2½ m.p.h. the 1¾-h.p. engine has a lever starter. This machine has been specially designed by the makers—the *Mayfield Engineering Ltd.*—for inter-row cultivation in young plantations and nurseries; it is well balanced and light to handle, so that accurate hoeing close to young trees is possible.

The 'Merry Tiller' is a self-propelled power unit which can be used for cultivating and weeding, for furrowing and ridging and for mowing and slashing, according to the attachment, which may be changed in one minute. *Wolseley Engineering Ltd.* offer two versions, the heavy-duty model having a 2½-h.p. Clinton engine and a reinforced frame.

This machine will dig up and mulch seedbeds in any soil up to a depth of 12 in. and a width of 44 in., providing, of course, there is no hard pan.

Scrubcutters

'Swipes' are tractor-powered rotary scrubcutters in several designs for operations ranging from light ground clearance to clearing any heavy scrub over which a medium- or high-powered tractor can be driven. They range from the simplest form of box-enclosed chain slasher, with a gearbox drive from the p.t.-o., to the 'Super Swipe', with a heavy-duty frame which will stand considerable rough usage. The rear guard of this h.d. model can be removed for cutting bulky material or for operations in reverse, such as edging up to a tree or wall. The makers are *Wolseley Engineering Ltd.*

The *Holt Weed Breaker Co.* were exhibiting for the first time their new Mk. XA three-gang bush breaker, the Mk. VIIIB weed breaker with a crushing weight of 1,400 lb. over a 5-ft. swath, and the Mk. VI three-gang weed breaker with a crushing weight of 376 lb. on a 7-ft. swath. They also showed a saddle-back toolbar fitted with Mk. VI sections for working over two lanes of a young plantation in one run.

Two models of the 'Scrubmasta'—the '52' and the '40'—were demonstrated by *John Wilder Ltd.* These machines, it was claimed, can tackle very tough conditions and will effectively clear scrub, bracken, brambles,

The Shawnee 'Warrior' can dig at right angles to the tractor

'Warrior' digger were its simplicity of design and its very sturdy construction. The makers—*Steel Fabricators Ltd.*—claimed that it had the highest power-to-weight ratio of any comparable machine. The machine, which can slew through an arc of 180°, will dig even at right angles to the tractor. The hydraulic circuit incorporates cushion valves, which ensure smooth operation. The stabilisers have a 7-ft. spread and are splayed at the rear of the tractor at an angle of 45°.

Plantation Cultivators

The 'Mayfield' motorised hoe is a sturdy, single-wheel power unit with a three-point cultivator, fitted to the toolframe, which may be 18 in. or 24 in. wide, according to order. The handlebars are adjustable for height and the two-speed gearbox gives a

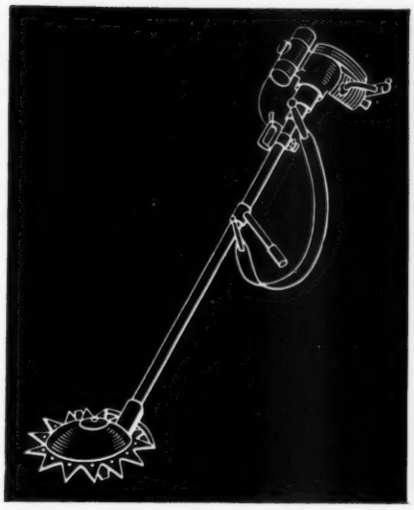
'Four Seasons' scrubcutter weeding a plantation of young trees overgrown with weeds

gorse, blackthorn and even young saplings. The machine consists of a rotor driven from the p.t.-o. and carried in a horizontal position on a two-wheel trailer. The rotor carries two rows of tines, which are flung out radially under centrifugal force and effectively pulverise many kinds of unwanted vegetation.

The 'Four Seasons' two-wheeled scrubcutter is a light and inexpensive machine with a robust performance for clearing overgrown land of gorse, heather, brambles, bracken, long and matted grass, saplings up to 2 in. dia. and coarse woody weeds on badly grazed pastures. One overseas user has stated that he cut as much brush in one hour with this machine as would have taken him three days to clear with hand tools. There are two models, one powered by a 98-c.c. Villiers engine and the other with a 147-c.c. engine of the same make. The *Standard Insulator Co. Ltd.* are the manufacturers.

The outstanding feature of the 'Locust' two-wheeled scrubcutter is the adjustment for cutting height, which can be varied from ground level to a height of 12 in. Its $3\frac{1}{2}$-h.p. Clinton engine provides the power necessary to deal with stubborn and tangled undergrowth at any desired height. The handlebars are adjustable with four working positions and the rotor may either be fitted with hardened steel blades, or chains may be used where it is desired to bruise and shred the growths. The makers—*Saunders Mead Ltd.*—claim that it will clear up to 3 acres of scrub in a day.

The *Cooper-Stewart Engineering Co. Ltd.* offered two motor-driven rotary scythes, which are carried by the operator by means of a shoulder strap and directed into the undergrowth. One model is powered by a 0.8-h.p. engine and the other by a 1.5- or 1.8-h.p. JLO engine. The engine and its small petrol tank are at one end of a hollow shaft and the rotating circular cutter is at the other; the two are connected by a rotating shaft fitted with helical gears.



The shoulder-mounted Cooper-Stewart rotary scythe

Grass Cutters

The 'Mayfield' is a sturdy single-wheel powered unit, which is designed by its makers—the *Mayfield Engineering Co. Ltd.*—to take a variety of implements. Among these there is a 2-ft. reciprocating cutter bar, which is ideal for dealing with heavy grass and tall weeds, such as thistles and foxgloves, growing on the verges of forest roads and young plantations. It has a $1\frac{3}{4}$-h.p. engine with slow-running control and fitted with an oil-bath air cleaner.

The 'Merry Tiller' offered by the *Wolseley Engineering Co. Ltd.* can be fitted with a rotary grass cutter, which can be easily attached or replaced with another implement. For this purpose it is used as a two-wheeled power unit and it is driven by a $2\frac{1}{2}$-h.p. Clinton engine.

'Sabre' scrubcutter with a 4-in., 100-tooth saw blade by J. Foster & Co. Ltd.

'Scrub-Masta 52' clearing a dense growth of saplings and brambles in the New Forest

Tractors

The 'Triple-D' or *Doe's* 'Dual Drive' tractor is basically two *Fordson* 'Power

Heavy-tyred motor scythe offered by the Mayfield Engineering Co. Ltd.

It is possible to slew the front power unit almost to a right angle in relation to the rear power unit of the Doe 'Dual Drive' tractor

Major' engine units made into a single unit of 100 h.p. This power, coupled with four-wheel drive, offers tremendous possibilities as a motive unit for timber haulage.

The two engines are arranged in tandem and with powered steering; it is easily possible to slew the front power unit almost to a right angle in relation to the rear power unit, so producing a tight turning circle of 21 ft. 6 in. This is a valuable asset when operating in confined spaces.

On uneven ground, usual in forestry operations, it is also possible for one of the wheels to be 20 in. higher than the other three, thus giving full four-wheel power at an angle of 17° on either side of the vertical axis. Provision is also made for the fitting of strakes or cage wheels without interference with the steering.

The 'Bombardier' muskeg tractor, shown by the *Rolba Co. Ltd.*, the agent in U.K. for *Bombardier Snowmobile Ltd.*, of Canada, is an amphibian fitted with a 115-h.p. Chrysler engine. It is described by the makers as an efficient off-road, all-season vehicle for operation on snow, marsh, peat swamp, heavy bush, steep slopes and rough ground. Its maximum speed in top gear is 25 m.p.h. and it has an 'on-tractor' payload capacity of 2,500 lb.

Although the unladen weight is over 2 tons, the ground pressure exerted by this tractor is less than 1 lb/sq. in., since the heavily reinforced watertight steel hull carrying all the heavy mechanical parts has a toboggan-type bottom and the weight is carried on two 28-in. wide crawler tracks.

The company also produces a monster weighing nearly 5 tons, over twice as long, for carrying 10,000 lb. of timber. This, too, exerts a ground pressure of only 1 lb./sq. in.

The 'Bristol'—essentially a handy tractor—is claimed by its makers—*Bristol Tractors Ltd.*—as probably the safest and most stable tractor in the world. This compact power unit can get through the closest spaced trees, while its unusually low centre of gravity gives it unusual stability on steep gradients.

The 32-h.p. *Perkins* diesel engine will give a drawbar pull of up to 5,000 lb. and, when fitted with 10-in. shoes, the ground pressure of the tractor amounts to only 4.5 lb./sq. in. There is a choice of tracks to suit different conditions and the overall width varies from the narrowest at 43 in. to the widest at 66 in. for operations on steep gradients in rugged conditions. It has three forward speeds and one reverse, operating speeds ranging from 1.5-5 m.p.h.

Road Making

Making and maintaining roads, levelling camp sites, filling holes and hollows, building dams, maintaining firebreaks in a clean condition are all jobs for the *Leeford* 'Twin Jack' hydraulic muledozer, demonstrated by *F. A. Hughes & Co. Ltd.*, which is a rigid and powerful implement designed to work with the 30- to 40-h.p. class of tractor. There were straight, angled and 'V' blades on show.

Winches

C. M. Hesford & Co. Ltd. were showing two three - point linkage tractor-mounted winches to pull 7,000 lb. and 12,000 lb. respectively and three permanently mounted winches: the 'Big Minor' with 10,000-lb. pull, the STD winch with 14,000-lb. pull and the 'Hercules' two-speed winch with a 20,000-lb. pull.

Their hydraulically - controlled, heavy-linkage, tractor-powered winch was demonstrated for the first time after having been on test for several months. In this new model the cone clutch and the sprag are actuated hydraulically, and it is stated that the H.L. winch pulls with the smoothness of a slip clutch and the firmness of a dog clutch.

The versatile 'Land-Rover' was shown by the *Rover Co. Ltd.* as fitted with their hydraulic capstan winch, which can exert a line pull of up to 4,000 lb. The hydraulic system, which gives it flexibility in operation, is engaged by the centre p.t.-o. lever and control thereafter is from a hydraulic valve within easy reach of the driver. There is a device to prevent a 4,000-lb. line pull from being exceeded.

Logging Arches

The *Boughton* logging arches seen at the show were of rugged all-steel construction and were designed to be fitted to the tractor drawbar. By lifting the winch rope clear of the ground one end of the log is hoisted clear of

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the ground and only the small end comes in contact with the ground. The bulk of the weight is thus taken by the arch and, with the butt end off the ground, friction is greatly reduced. This not only prevents undue damage to the roads or grassland over which the load is drawn, but cleaner logs are delivered to the sawmill.

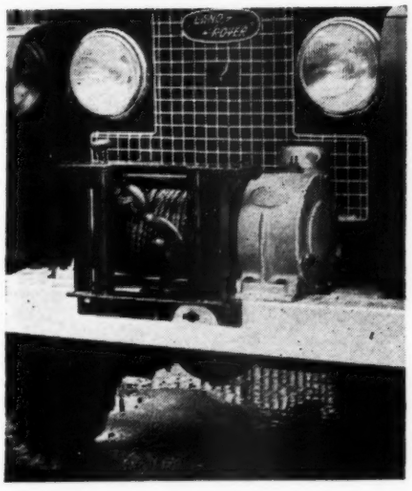
Timber Loaders

The *Cundey* hydraulic bolsters will convert any suitable flat-topped lorry chassis into a self-loading timber carrier complete with quick-release stakes for unloading and timber retainers for holding the load securely. There is a larger unit for lifting a total weight of up to 2 tons of logs on to an articulated wagon and a smaller unit for mounting on an ordinary lorry chassis to lift a total weight of 15 cwt. with timber up to 20 ft. in length.

Chain Saws

McCulloch chain saws, which were exhibited on the stand of the *Cooper-Stewart Engineering Co. Ltd.*, have been 'torture-tested', according to the manufacturers, *McCulloch International Inc.*, of U.S.A. The tests included starting and operating tests in arctic cold and desert heat, variable-load and variable-speed continuous runs for hundreds of hours and starting and acceleration cycles for 50,000 times without failure. There are three types of drill attachments which can be fitted to three of their seven models —a brushcutter, a soil auger and a simple boring drill for stump blasting.

The importance of the power saw chain was emphasised by *Sandvik Swedish Steels Ltd.* The Sandvik chain is made of chromium-nickel alloy steel. Special heat treatment and electrolytic chromium plating explains why the chain stays sharp so long. It is assembled on rolled rivets, reinforced by a spinning on each rivet. The bearing surfaces are high-frequency hardened, which makes the chain stronger and longer lasting. A useful booklet on the care and maintenance of saw chains was presented to us.



Hydraulic capstan winch fitted to a Land-Rover

The amphibian 'Bombardier' muskeg tractor being used for hauling logs in a forest swamp

Fordson Major tractor fitted with a Boughton winch

The principal exhibit of the *Trojan Co.* was an extremely robust one-man chain saw designed for felling, log cutting, parallel slicing and lopping. Lightweight ease of operation is assured through the design of the blade and the run of the chain, so allowing for the more difficult jobs of root cutting, overhead cutting and flush to the ground felling, with the thumb on a push button for chain oiling. Saws are available for varying lengths of guide bars from 14-42 in.

Your motor mower can now provide power to drive a hedgecutter, pruning saw or even a chain saw, since the introduction of the *Tarpen-Strand* flexible shaft drive, which was demonstrated by the *Standard Insulator Co. Ltd.*, and p.t.-o. attachments are now available for all the current models. The flexible shaft is offered in 10-ft., 12-ft. and 15-ft. lengths.

Two new products of *Pioneer Saws Ltd.*, of Canada, were demonstrated by *E. P. Barrus Ltd.* The light, handy and versatile Pioneer '400' weighs only 19 lb. and has all five controls, including ignition switch and carburettor adjuster, conveniently arranged in a cluster on the pistol grip. The Pioneer '600' is a heavier and very rugged model with a high cutting speed and with the power unit well shielded from dust, sawdust and snow. Saws for the first are available from 12-20 in. and for the other from 16-32 in. There is a still larger model—the '800'.

Two outstanding features were noted in the chain saws shown by

Watveare Overseas Ltd. Firstly, all guide bars have the Remington roller-bearing nose and, secondly, they carry the Remington side-planer chain with cantilever teeth, which, it was claimed, gives greater cutting power and greater strength. The roller-bearing nose has reduced the power requirements by at least 20%, and the turbo-blast cooling system ensures that a large volume of air moves across the cylinder fins. The manufacturers are the *Remington Arms Co. Inc.*, of Canada.

The 'Solosaw', seen on the stand of *Minok Engineering Co. Ltd.* can be used in any position without the necessity of tilting or swinging the saw blade. An automatic centrifugal clutch protects the engine from overstrain and the air inlet is shielded to prevent the entry of sawdust and snow. A built-in pressure lubrication pump supplies oil to the chain during operations. The saw can safely be carried from tree to tree with the engine running, since when idling the chain stops.

The 'Solosaw' is a handy tool for felling trees and cutting logs

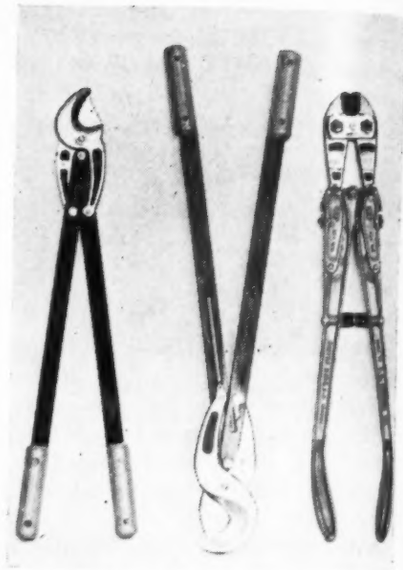
Woodworking Machinery

Stenners of Tiverton Ltd. were, for obvious reasons, not able to show us their log conversion machinery, but two of the machines illustrated on their stand were the transportable log band-saw, type VXJ, for making cut timber from logs, and the transportable circular bushmill, type RA, for reducing large tree trunks to planking.

Hand Tools

Wm. A. Meyer Ltd. were showing the complete range of 'Bushman' forestry tools made of Swedish steel and manufactured by *Edsbyns Industri Aktiebolag*, of Sweden. These included saw blades, bow saws, one-man and two-man cross-cut saws, pruning saws, barking irons, felling wedges, log gauges, log-lifting hooks, lifting tongs, chain tighteners and ingenious seeding and planting tools.

Various types of pole pruners, long-tong cutters and lopping shears made by *H. K. Porter Inc.*, of U.S.A., were offered by *E. P. Barrus Ltd.* These sturdy tools will appeal to fruit and nut growers, tree surgeons and foresters.



H. K. Porter point-cut pruner, heavy-duty brush cutter and high-power shears

The irksome job of refiling worn saw blades is not necessary with the *Sandvik* 'Hard-Point' blade, for the extra hardened tip gives threefold wear. The manufacturers claim that these tip-hardened bow saw blades will stay sharp three times longer than ordinary blades and that it is a paying proposition to take a new blade instead of wasting time filing worn blades. *Sandvik Swedish Steels Ltd.*, are specialists in the design of bow saw frames of high tension power fitted with narrow blades to make the work easier.

Petter powered sawbenches in a forest clearing scheme being carried out by the Northern Ireland Government Board

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Agricultural Chemicals

Worms in Apples

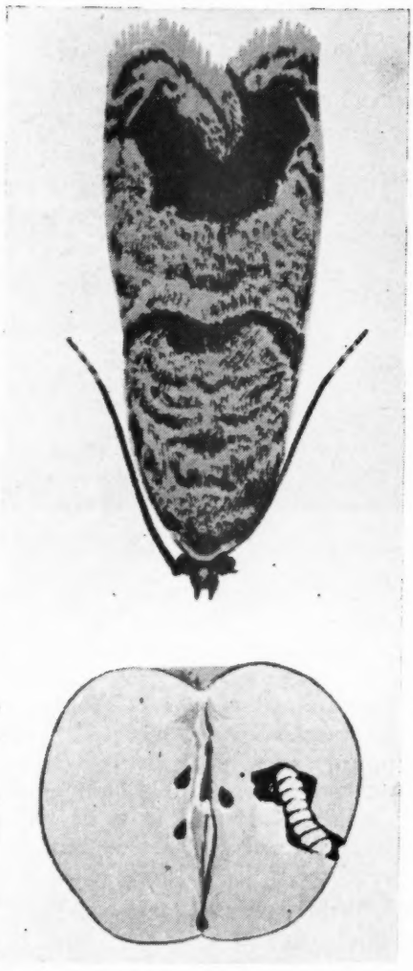
The codling moth is the most persistent, destructive and difficult to control of all the insect pests affecting apples. If left to itself, *i.e.* with no control whatever, it will infest from 20%-95% of all the apples in an orchard. The pest is especially abundant and hard to control where there is a long growing season and summer temperatures are high.

The brownish-grey moths, about ½ in. long, begin to appear soon after apple blossom time and lay their white pinhead eggs on leaves close to the inflorescences; later on eggs are laid directly on the growing fruit. The eggs hatch in a few days or weeks, according to the temperature, and the emerging larvae enter the apples. In two or three weeks the worm becomes full grown, being about ¾ in. long and white to pink in colour. It then leaves the fruit and spins a cocoon under a loose flake of bark, or in trash on the ground; then they become moths and the life cycle is repeated, with a second and later a third brood of worms being produced in mid-season, so effectively ruining the crop.

Since 1945 the principal method of control was by spraying with DDT, but there is now a more effective material available, known as 'Sevin' insecticide—a carbamate formulation —which is produced by the *Union Carbide Corporation* of the U.S.A. Recent tests have shown that sprays applied even after the worms have entered the fruit will still give an excellent kill and so reduce worm damage to the point of almost non-existence.

Problem of Resistance

DDT and the other chlorinated hydrocarbon insecticides have done a marvellous job in the control of insect pests in remote areas, where formerly agricultural populations would be periodically incapacitated by serious malarial epidemics and weakened by dysentery and other bowel complaints. People who are sick cannot work or cannot work efficiently and it is essential that the surroundings of



The codling moth and the apple worm it produces

estate bungalows and labour lines, and also farm settlements in new areas, should be regularly sprayed.

Unfortunately, in the course of a few years the surviving, more resistant insects may build up a population of insect strains which are not seriously affected by the chlorinated hydrocarbon insecticides. For several years the search has gone on for other chemical groups which would overcome this resistance problem and the organo-phosphorus compounds have finally provided the solution.

The early products, such as parathion, while very effective insecticides, were far too toxic to use in such operations, but in recent years other compounds have been discovered which offer the high activity of the organo-phosphorus compounds with relatively low mammalian toxicity. One of these is diazonin, a product first synthesised in the research laboratories of *J. R. Geigy S.A.*, of Switzerland, and now being distributed by *Fisons Chemicals (Export) Ltd.*

This new product, it is claimed, offers positive, dependable control of resistant, as well as non-resistant, insect pests, including flies, mosquitoes, midges, cockroaches, bed bugs, ants and silver fish. In agriculture, diazonin sprays are also used to suppress mites and control a broad range of pests on fruit and vegetable crops. Further details are given in a manual entitled 'Fisons Chemicals for Public Health'.

Pre-emergence Spraying

A new approach to weed control in peas, broad beans and tick beans is to spray the weeds before they appear. 'Residuren', which incorporates 'Karmex' (Diuron)—a *Du Pont* product — is distributed in the U.K. by *Farm Protection Ltd.*—is a mixture of selective weedkiller formulated to prevent the germination of a wide range of seedling weeds in any weather and temperature conditions.

The soil should be clean and free from weeds when sprayed and should be freshly cultivated to a fine, even tilth, especially if the soil is moist or damp. The object is to establish an active and persistent film of herbicide on the surface which will prevent the emergence of weed seedlings for some time after application. The spray should be applied as near to crop emergence as possible to obtain the maximum control of weeds, when the crop is most vulnerable and weed emergence is rapid.

The warning is given by the manufacturers that 'Residuren' will only kill germinating weed seedlings; it will not kill already established perennials or couch grass. There may also be some suppression of wild oats, germinating near the surface, but control of this weed is usually insufficient from the surface application of this herbicide.

Soil-borne Pests

A soil fumigant is a volatile chemical which is injected into the soil to control certain pests that menace crop yields. They act by liberating a poisonous vapour which spreads in all directions through the soil. The pests mainly concerned are known as plant nematodes or eelworms. These are minute, round worms—about the size of a full stop—which are parasitic to plants and may be found in immense numbers in the soil, particularly in areas that have a warm, damp climate, though in temperate regions populations of nematodes may also build up in soils in which tomatoes, sugar-beet and potatoes have been grown repeatedly.

Damage is done to the plants due to the nematodes feeding on the plant tissues. The nematode may actually kill a plant root cell or it may interfere with its normal functioning. If the cell is not killed, it may enlarge or multiply, leading to the formation of galls or other abnormal growths, which reduce the efficiency of the root system as a carrier of food and water into the plant.

Stunting and poor growth, often with pale, wilted leaves and a limp, half-grown appearance, which may be mistaken for lack of fertiliser or water, are the chief above-ground symptoms of the attack. As the pest is not evenly distributed in the soil, not all plants in a field are attacked immediately and the field will present an uneven appearance, due to patches of stunted and normal plants in juxtaposition.

The chief economic crops liable to attack are tobacco, citrus, cotton, pineapple, tea, coffee, sugar-cane, pepper, potatoes, sugar-beet and certain types of flowers. Tomatoes, celery, carrots, lettuces are the chief glasshouse crops that are affected. Effective control of the pest on these crops will obviously mean better plants, higher yields and increased profit; without effective control it may be impossible to grow them repeatedly in the same soil.

Cultural control methods, such as crop rotation and fallowing, may reduce the nematode population, but such practices can be costly. A grower whose income comes from the sole-crop cultivation of a nematode-susceptible plant, such as tobacco or pineapples, could be ruined by a total crop failure.

Venezuela. Potato plant severely attacked by nematodes

Soil fumigation helps to keep land free of these pests and 'D-D' is a product which has stood the test of time. It is a moderately volatile, dark brown liquid mixture of chlorinated hydrocarbons made by *Shell*. The principal constituents are 1,3-dichloropropene and 1,2-dichloropropane. Further particulars are to be found in an attractive illustrated brochure produced by the company called 'Soil Fumigation with D-D'.

Death to Rats

Murphy ' Warfarin ' bait would appear to be the ideal rodenticide for use by those who have to control the rats in their farm buildings, grain stores, poultry houses and warehouses without professional assistance, for the laying of the bait is so simple. This ready-mixed bait is clean to handle and makes no mess; rats and mice will feed avidly upon it until every member of the colony is dead, usually within 10 days. After this all that is necessary is to maintain one or more permanent baiting points to keep the premises free from rodents.

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One Oz.—Half Acre

Believe it or not, 1 oz. of 'Microcal' has a surface area of approximately ½ acre. Great surface area and extremely fine particle size are the important characteristics of the silica and silicate fillers made by *Joseph Crosfield & Sons Ltd.* From these characteristics stem the properties of absorption, reinforcement, suspensions, matting, mild abrasion, anti-caking, carrying and dispersion, which are made use of in the preparation of insecticides and natural and synthetic rubbers.

Tanalised Timber

A series of stringent tests carried out on 'Tanalith C' treated timber has proved that, whilst being toxic to insects and fungi, the preservative is not a hazard to humans, livestock or plants. The tests are described in a booklet, entitled 'The Safety of Tanalised Timber', obtainable from *Hickson's Timber Impregnation Co. (G.B.) Ltd.* through our Reader Service.

World Crop Reports

World Production Down 3%

INTERNATIONAL REPORT

World crop production

World crop production in 1959-60 was about 3% below the record production of 1958-59, despite new high levels of output for several major crops. Production in 1959-60, however, was the second highest on record and 18% above the 1950-54 average. The increase in population over the same period, since 1950-54, has been about 14%, so that *per capita* crop production in 1959-60 was about 4% above average.

The decline in *wheat* production of 600 million bushels was a major factor in the smaller crop output of 1959-60. The 8.1 billion bushel crop is about equal to the past year's consumption and on 1 January, 1960, the carry-over of wheat in major exporting countries was slightly below a year earlier. Other crops recording marked declines in output were *oats*, *deciduous fruits* and *sunflower seed*. Smaller declines (6% or less) were recorded by *rice*, *rye*, *sugar*, *barley*, *dry beans*, *flaxseed*, *soya beans*, *potatoes* and *groundnuts*.

The record crops of *maize*, *cotton*, *coffee* and *cacao* were all considerably above the output in 1958-59. Smaller increases were also recorded in several minor crops, but these increases were not sufficient to offset the declines reported above.

While *per capita* production of these crops was above the 1950-54 average, consumption is high and only a few significant increases in carry-over are expected at the end of the 1959-60 season. Unusually favourable weather and expanded plantings in coffee-producing countries is resulting in total crops being considerably above expected consumption. This will further increase stocks carried over into the next season. Cacao production also set a new record in 1959-60, exceeding 1958-59 by nearly 10%, and is likely to exceed consumption in the current season. Cotton consumption, however, has increased sufficiently so that, even with the current record production this year, stocks are not expected to increase during the 1959-60 season.

Feed grain production in 1959-60 may exceed the record consumption. The sharp increase in maize production and the continued high level of the U.S. sorghum crop has resulted in yet another record world feed supply. On 1 January, 1960, feed grain stocks in leading exporting countries were about 3% higher than a year earlier and were at a record high level.

The 1959 total output of vegetable *oils* and *oilseeds* (in oil equivalent) was about the same as in 1958, despite record cottonseed and large olive oil crops. Groundnut production was slightly below both 1958 and 1957; the soya bean and flaxseed crops were smaller, due to reduced North American crops, and copra production continued to decline.

REGIONAL REPORTS

Yugoslavia

For the first time in its history Yugoslavia in 1959 was self-supporting in *wheat*, having filled the annual gap of 500,000 tons—the difference between production and consumption. This, according to an FAO report, was achieved through the mass introduction of high - yielding Italian varieties of wheat and the use of better agricultural practices, such as deep and better ploughing, abundant applications of potash and phosphorus fertilisers and winter applications of nitrogen.

The project was started in 1957, with the help of Italian technicians from the Ente Nazionale Sementi Elette (National Seed Improvement Association), but was taken over the following year by FAO with five Italian experts to carry out the project and help the Yugoslav technicians organise the distribution of Italian wheat seed.

In 1959 the total area under wheat in Yugoslavia was about 5 million acres, of which 750,000 acres were sown with Italian varieties. The total production of the country was about 2 million tons, and of this figure Italian wheats yielded 600,000 tons. Thus, although Italian wheats were sown on only 14.8% of the acreage, they produced 30% of the total production. The most striking result, however, is that Italian wheat varieties give higher yields in Yugoslavia than in Italy, not only on the experimental stations, but also on ordinary farms. In several instances production reached a record of 10 tons per acre.

These figures seem to indicate that the soils of Yugoslavia contain organic matter as well as minerals in sufficient quantities to grow good crops. But the primitive farming practices which are common in many parts of the country, and insufficient use of fertilisers, cause impoverishment of the soil. Climatic conditions are generally favourable on the vast plains of Vojvodina, Serbia, Croatia and Slovenia, with an even rainfall and very rare periods of drought. Apart from the fertile valleys, there are large areas of hill country in Serbia, Kosmet and Macedonia, where there are poor clay soils and much less favourable climatic conditions, but where excellent results are achieved.

In view of these remarkable results, Yugoslavia has decided to expand the project and will sow 2 million acres with Italian varieties in 1960. New types will be tested with the object of ultimately replacing the local varieties.

Sudan

The 1959-60 cotton crop now being harvested in Sudan is expected to reach 635,000 bales (500 lb. gross). This would be 11% above last season's 573,000 bales and 3% more than the previous record of 617,000 bales in 1956-57.

The increase this year is in extra-long-staple varieties, production of which rose to 610,000 bales from 524,000 bales in 1958-59. The opening of the second phase of the Managil Extension in the Gezira, plus larger plantings on private estates, boosted the area planted to extra-long staples (all irrigated) to a record 755,000 acres —up 19% from 634,000 acres in 1958-59. The plans call for further expansion of extra-long-staple acreage

as additional phases of the Managil Extension are completed, although there may be insufficient labour.

Production of American-type (upland) cotton, mostly rain-grown, is estimated at 25,000 bales, compared with 48,000 bales in 1958-59. The 196,000 acres planted to upland cotton this season was 22% below last season. Lower cotton prices last season caused some farmers in upland-type producing areas to change to other crops.

Madagascar

Agricultural production in the Malgache Republic (Madagascar) is expected to recover somewhat this year from the disastrous cyclone of early 1959.

Rice prospects are particularly good. The Government recently estimated the 1960 paddy *rice* production at 1,250,000 metric tons, or 50,000 tons more than the record crop of 1958. Rice has become one of the leading export crops; *coffee* is the most valuable, but *vanilla* exports are increasing steadily in value. Coffee, rice, vanilla, *sugar* and *cloves* accounted for two-thirds of the exports by value in 1958.

Coffee production for 1960 is estimated at 50,000 metric tons, against 56,000 tons in 1958. The reduction is a residual loss from last year's cyclone. Vanilla output is estimated at 380 tons —about 60 tons below 1958—also the result of cyclone damage. *Cotton* production is forecast at 4,800 bales (500 lb.).

A quota of 3,800 tons of Maryland tobacco has been set for export to France between August and October 1960. A gradual shift to production of flue-cured types is planned. The Republic also plans to increase and diversify other agricultural production and to make its large cattle numbers more profitable.

Groundnut production is forecast at 40,000 tons for 1960, with 45% for export. Expansion is planned for *black pepper* (708 metric tons produced in 1958). *Tea* and *cocoa* production will be further encouraged on the moist east coast and in the Sambirano area. The island hopes to expand sugar production so that systematic exports of 40,000-45,000 tons of raw and refined sugar will soon be possible. Higher-yielding and disease-resistant canes adaptable to mechanisation have been introduced.

Poland

As early as mid-January 1960 the Polish press indicated that prospects were not good for winter crops (*rye, wheat, rape and vetches*). The drought which began in the summer of 1959 delayed the autumn sowing; only 90% of the planned areas was sown and winter grain on 30% of the seeded area germinated very poorly. It was estimated in January that at least 2.2 million acres would have to be reseeded in the spring.

According to more recent reports, the drought persisted through the winter and into March, and light snowfall and severe cold have caused winter damage. Also with ground moisture very low wind erosion has been common. A reported fertiliser shortage does not brighten the outlook.

Portugal

Portugal's 1960 *almond* crop is forecast at 3,000 short tons. The crop in Algarve, the main producing area, was reported damaged by severe winds during the blooming period; however, the crop in Douro is said to be normal. The 1960 forecast is about 1,800 tons below the 1959 harvest, which was slightly above average 1953-57 production of 4,600 tons.

Burma

Burma's 1959-60 *groundnut* crop is expected to be only slightly above last year's out-turn, but *sesame seed* production has risen 30%. These are the only oilseeds grown on a major scale in Burma.

Two crops of groundnuts are grown —a 'rain crop' harvested in September-October and a 'cold-season crop' harvested in March-April of the following year. Acreage in 1959-60 was up about 5% from the year before, but the average yield of the rain crop was down and the yield of the crop now being harvested is also lower than last year. However, total production should be up around 2%.

The 1959-60 groundnut harvest is estimated at 323,000 short tons from 1,052,000 acres sown. Last season's output (final official estimate) was 318,000 short tons from 1,004,000 acres.

A sizable increase in acreage and yields accounts for the sharp upturn in production of sesame seed this season. According to the third official estimate, 1959-60 production of sesame seed is 75,000 short tons from 1,544,000 acres sown. Production in 1958-59 (final official estimate) was 58,000 short tons from 1,410,000 acres sown.

England and Wales

The weather during April was changeable and rather warm during the first half of the month. Falls of rain were substantial in northern and western districts, but small over the remainder of the country. Dry, sunny weather followed and eastern districts were cold due to the prevalence of northerly winds; ground frost was widespread.

In most areas the sowing of *spring corn* was completed under favourable conditions. The land worked fairly well and, in general, good seedbeds were obtained.

Autumn-sown *wheat*, *barley* and *oats* were satisfactory and growing well in most areas. In some districts growth was retarded by cold conditions and yellowing was reported. Spring-sown wheat, barley and oats germinated satisfactorily, but on the whole were making slow growth, although some early-sown crops were vigorous. *Rye* and *mixed corn* were generally satisfactory. *Winter beans* had wintered well and were making good progress. *Spring beans* germinated well; some weevil damage was reported. *Peas for stockfeeding* made satisfactory progress; damage by birds was reported from some eastern counties.

Conditions were favourable for planting maincrop *potatoes* during the month and good progress was made. Many crops of early potatoes suffered some frost damage.

Good progress was made with the preparation of land for *root crops*; on the whole the land worked well and good seedbeds were obtained. The sowing of *sugar-beet* was virtually complete and the drilling of *mangolds* and other root crops had commenced in many areas. Preparation of the land for *kale* was satisfactory and early sowings were completed in good seedbed conditions.

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